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CONTRIBUTIONS TO THE BIOLOGY OF THE PHILIPPINE ARCHIPELAGO AND ADJACENT REGIONS

THE MACROUROID FISHES OF THE PHILIPPINE ISLANDS AND THE EAST INDIES

By CHARLES HENRY GILBERT
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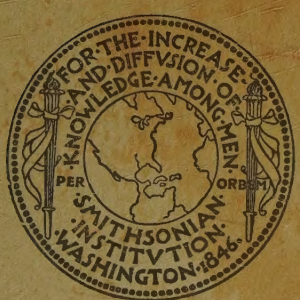
Of Museum of Zoology, University of Michigan



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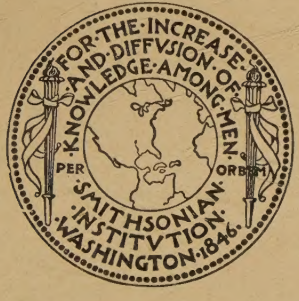

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THE MACROURIOID FISHES OF THE PHILIPPINE ISLANDS AND THE EAST INDIES.

By Charles Henry Gilbert,
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Of Museum of Zoology, University of Michigan.

I. INTRODUCTION.

Twenty-seven of the new species of the Coryphaenoididae obtained during the Philippine cruise of the fisheries steamer *Albatross* have been described in a paper by Lewis Radcliffe.[1] The entire collection, through the kindness of Dr. Hugh M. Smith, was placed in the hands of the present writers that they might test the constancy of the characters used by them in a revision of the genera.[2] It soon became apparent, however, that the collection contained many additional undescribed forms, and the authors undertook to prepare this detailed report on the entire material, which contains nearly 1,500 specimens.

The following genus, subgenera (8), species (30), and subspecies (1) are described as new to science:

Bathygadus spongiceps, new species.
Bathygadus entomelas, new species.
Gadomus denticulatus, new species.
Gadomus magnifilis, new species.
Gadomus intermiger, new species.
Coryphaenoides semiscaber, new species.
Hyomacrurus, new subgenus.
(Genus *Coelorhynchus* Giorno.)
Quincuncia, new subgenus.
C. quincunciatus, new species.
C. thompsoni, new species.
(Subgenus *Paramacrurus* Bleeker.)
C. maculatus, new species.
C. velifer, new species.
C. sexradiatus, new species.
C. triocellatus, new species.

[1] Proc. U. S. Nat. Mus., vol. 43, 1913 (Sept. 27, 1912), pp. 105–140.
[2] Published by the writers in their Report on the Japanese Macrouroid Fishes (Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 135–214).

C. dorsalis, new species.
C. macrolepis, new species.
C. cingulatus, new species.
(Subgenus *Oxymacrurus* Bleeker.)
C. acantholepis, new species.
C. carinifer, new species.
C. smithi, new species.
C. radcliffei, new species.
C. weberi, new species.
Oxygadus, new subgenus.
C. spinifer, new species.
(Genus *Hymenocephalus* Giglioli.)
Hymenogadus, new subgenus.
H. gracilis, new species.
(Subgenus *Hymenocephalus.*)
H. striatissimus aeger, new subspecies.
H. nascens, new species.
Papyrocephalus, new subgenus.
H. barbatulus, new species.
Malacocephalus luzonensis, new species.
Ventrifossa, new genus.
Atherodus, new subgenus.
Lucigadella, new subgenus.
Lucigadus, new subgenus.
Subgenus *Ventrifossa.*
V. nigrodorsalis, new species.
V. divergens, new species.
Lionurus infranudis, new species.
Lionurus evides, new species.
Lionurus decimalis, new species.

In addition to the systematic descriptions, we have prepared analytical keys to the species of several of the larger genera, each key being the result of a study of the relationships throughout the world of all the known species in the given genus.

Methods of measuring and counting.—In order to insure greater accuracy we have made large numbers of counts and measurements, following generally the methods explained in our Japanese report,[1] but with certain minor alterations which are of quite evident nature.

II. SOME RESULTS OF GENERAL BIOLOGICAL INTEREST.

The present work has thrown some light on the biology of the Coryphaenoididae, the family of fishes represented most abundantly in the depths of the sea.

[1] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 147–148.

Sexual dimorphism.—We have been able to demonstrate the existence of sexual dimorphism in this family for the first time. In certain species of *Coelorhynchus* (*C. velifer* and its allies, *q. v.*) the first dorsal, pectoral, and ventral fins are decidedly longer in the adult males than in the females or the young males. The wide variation[1] in the length of the outer ventral ray in the subarctic *Coryphaenoides cinereus* upon reinvestigation is shown to be due likewise to sexual dimorphism: the ray is produced into a long strengthened filament in the male. In most species of the family no marked sexual variation in the length of the fins is evident.

Age determinations.—We have made a short study of the scales of the species of *Gadomus*, as presented in more detail under the head of the four species of that genus here reported on. The scales of *G. denticulatus* especially show certain marks which greatly resemble the so-called "annuli" of certain littoral fishes, and are probably indications of a yearly check in the growth of the fish. These marks are very obscure or entirely absent in the species inhabiting the greater depths.

Subspecific intergradation.—The intergrading of the geographical subspecies of *Hymenocephalus striatissimus* has been worked out in detail. So far as known to us this is the first demonstration of its kind among the bathybial fishes.

Distribution correlated with temperature and depth.—The region of the Jolo or Sulu Sea forms a partly inclosed basin connected with open waters by narrow and comparatively shallow channels; the water of the sea is consequently rendered warm, retaining a temperature of more than 49° F. to depths of over 1,000 fathoms. Though of comparatively small size, the Philippine faunal subregion, comprising these waters of unusually high temperatures at great depths, contains a large proportion of peculiar and frequently very distinct species, which have probably been evolved in this region of peculiar environmental conditions. The process of their evolution has doubtless been aided or hastened by their isolation, more or less complete, in this partly inclosed sea.[2]

III. THE GEOGRAPHICAL DISTRIBUTION OF THE MACROUROID FISHES OF THE PHILIPPINE AND ADJACENT ISLANDS.

There are now known about the East Indian and the Philippine Islands no fewer than 75 or 76 species[3] of the Coryphaenoididae. In no other area of similar size is there known a fauna comprising such a numerous and varied assemblage of these fishes.

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[1] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 107.

[2] Some of the species range northward to southwestern Luzon.

[3] Including the three subspecies of *Hymenocephalus striatissimus;* 69 of these species were obtained by the *Albatross.*

1. COMPARISON WITH OTHER FAUNAS.

For the purpose of our faunal analysis there are three other regions suitable for comparative study in this family; these comparable faunas are the Indian, the Japanese, and the Hawaiian. As might be expected, these four faunas are more closely related to each other than they are to the fauna of the eastern and northern Pacific, or to that of the northern Atlantic, the other regions where an extensive exploration of the continental shelf has been made.

But few of the many species of Macrouroid fishes belonging to the East Indian-Philippine fauna are known in other regions. Careful comparison has led us to conclude that not one of these species is known about the Hawaiian Islands. Four of the species are identified by us with Indian forms, without actual comparison of material in any case. These are: *Bathygadus furvescens*, *Bathygadus multifilis* (?), *Ventrifossa petersonii* (?), and *Lionurus pumiliceps*.[1] Eight species are identified as also Japanese: *Gadomus multifilis*, **Coelorhynchus parallelus*, **Hymenocephalus s. striatissimus*, **Ventrifossa misakia*, *Lionurus proximus*, **L. spinosus*, *Trachonurus villosus*, and *Cetonurus robustus;* but those above starred are known in the Philippines only from a few young specimens taken in eastern Luzon, and the material was too inadequate, except in the case of the *Hymenocephalus*, to make their identification certain.

Although so few of the species are identified with those of other faunas, many are represented in the three other regions by very closely allied or geminate species, as listed in the following tables (from which all notably distinct species are excluded).

1. *Table indicating the geminate species occurring in the East Indian-Philippine region and about the Hawaiian Islands.*

East Indian-Philippine species.	Hawaiian species.
Bathygadus spongiceps [2]	*B. bowersi.*
Gadomus multifilis [3]	*G. melanopterus.*
Hymenocephalus gracilis	*H. tenuis.*
Hymenocephalus nascens	*H. striatulus.*
Lionurus pumiliceps [4]	*L. gibber.*
Mataeocephalus nigrescens [5]	*M. acipenserinus.*
Trachonurus villosus [6]	*T. sentipellis.*

[1] It is possible that *Coelorhynchus parallelus* and *Malacocephalus laevis*, or allied forms of these, should be included.
[2] Very close also to *B. cottoides* from near New Zealand and the Kermadec Islands.
[3] Occurs also in Japan and probably in the Indian Ocean.
[4] Occurs also in the Indian Ocean.
[5] Very close also to *M. tenuicauda* of the Panama fauna.
[6] Occurs also in Japan; close also to Atlantic species.

2. *Table indicating the geminate species occurring in the East Indian-Philippine region and in the Indian fauna.*

East Indian–Philippine species.	Indian species.
Coryphaenoides asprellus	*C. hoskynii.*
Coryphaenoides semiscaber	*C. macrolophus.*
Coryphaenoides tydemani	*C. macrolophus.*
Coelorhynchus smithi	*C. flabellispinis.*
Lionurus proximus	*L. brevirostris.*
Mataeocephalus adustus	*M. microstomus.*

3. *Table indicating the geminate species occurring in the East Indian-Philippine region and the Japanese fauna.*

East Indian–Philippine species.	Japanese species.
Gadomus denticulatus	*G. colletti.*
Coryphaenoides microps	*C. marginatus.*
Coelorhynchus weberi	*C. anatirostris.*
Coelorhynchus weberi	*C. productus.*
Coelorhynchus commutabilis	*C. japonicus.*
Hymenocephalus s. striatissimus [1]	*H. s. striatissimus.*
Hymenocephalus s. torvus	*H. s. striatissimus.*
Hymenocephalus s. aeger	*H. s. striatissimus.*
Hymenocephalus nascens	*H. lethonemus.*
Hymenocephalus barbatulus	*H. papyraceus.*
Ventrifossa divergens	*V. garmani.*
Lionurus evides	*L. condylura.*
Lionurus parvipes	*L. cetonuropsis.*

[1] Each of the three subspecies of distinct distribution.

It is thus apparent that the Macrouroid fauna most nearly related to that of the East Indies and the Philippine Islands is the fauna of Japan, which is probably largely derived from the southward.[1] These two faunas contain the largest number of species common to both, and they contain the largest number of geminate species; but this is not the only reason for considering them more closely related to each other than either is to any other known fauna. As corroborative evidence we may note that the *Coelorhynchus notatus* group of species from the Philippines and East Indies finds its only close relatives in *C. jordani* and *C. kishinouyei* of Japan, and that the remarkable subfamily Macrouroidinae is represented by but two species: *Macrouroides inflaticeps* of eastern Luzon and *Squalogadus modificatus* of Japan. In addition to *Macrouroides* and *Squalogadus*, there is but one genus not common to both regions, no representative of *Mataeocephalus* being yet known from Japan.

2. ANALYSIS OF THE EAST INDIAN-PHILIPPINE FAUNA.

The fauna of Macrouroid fishes in the East Indian and Philippine Islands has been compared with the faunas of other regions, and found to resemble that of Japan most closely. In order to determine the subdivisions of the fauna of the Philippines a distributional

[1] Excluding, of course, the three subarctic species reaching northern Japan (*Coryphaenoides pectoralis, C. acrolepis,* and *C. cinereus*).

table has been drawn up, in which the number of specimens of each species dredged by the *Albatross* is given for eight different regions; in addition the six or seven species [1] dredged in the East Indies only by the *Siboga* are marked by a cross (×) in the column for that region. No attempt is made to define the subdivisions in the East Indies for the Macrouroid fauna.

Ten columns are used, corresponding to the following regions:

1. Known also from the Indian fauna.
2. East Indian subregion.
3. Tawi Tawi (or Sulu) Archipelago, and the Gulf of Davao, southern Mindanao.
4. Philippine subregion (*q. v.*).
5. Eastern Mindanao.
6. Eastern Luzon.
7. Northern and northwestern Luzon.
8. Formosa.
9. Off Hongkong, China.
10. Known also from Japan.

Distributional lists of the species.

Species.	Regions.									
	1	2	3	4	5	6	7	8	9	10
Bathygadus spongiceps	.....	2	.....	2	.....	3	.....	.....	.....	.....
Bathygadus filamentosus	.....	4	.....	.....	.....	.....	.....	.....	.....	.....
Bathygadus entomelas	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
Bathygadus furvescens	×	1	.....	3	.....	1	.....	.....	.....	.....
Bathygadus sulcatus	.....	.....	.....	15	.....	.....	.....	.....	.....	.....
Gadomus denticulatus	.....	3	.....	7	.....	1	.....	.....	.....	.....
Gadomus magnifilis	.....	.....	.....	3	.....	.....	.....	.....	.....	.....
Gadomus introniger	.....	12	.....	1	.....	1	.....	.....	.....	.....
Gadomus multifilis	?×	2	.....	.....	.....	1	.....	.....	.....	×
Macrouroides inflaticeps	.....	.....	.....	.....	.....	1	.....	.....	.....	.....
Coryphaenoides paradoxus	.....	.....	.....	[1] 1	.....	.....	.....	.....	.....	.....
Coryphaenoides dubius	.....	.....	.....	1	.....	.....	.....	.....	.....	.....
Coryphaenoides asprellus	.....	[2] 1	.....	.....	.....	.....	.....	.....	.....	.....
Coryphaenoides semiscaber	.....	.....	.....	4	.....	.....	.....	.....	.....	.....
Coryphaenoides tydemani	.....	4	.....	.....	.....	.....	.....	.....	.....	.....
Coryphaenoides microps	.....	.....	.....	.....	.....	1	4	.....	.....	.....
Coryphaenoides hyostomus	.....	3	.....	4	.....	.....	.....	.....	.....	.....
Coryphaenoides heyningeni	.....	×	.....	.....	.....	.....	.....	.....	.....	.....
Coryphaenoides aequatoris	.....	[2] 2	.....	.....	.....	.....	.....	.....	.....	.....
Coryphaenoides orthogrammus	.....	[2] 1	.....	.....	.....	.....	.....	.....	.....	.....
Coryphaenoides camurus	.....	.....	.....	[2] 1	.....	.....	.....	.....	.....	.....
Coryphaenoides sp. Weber	.....	×	.....	.....	.....	.....	.....	.....	.....	.....
Coelorhynchus argentatus	.....	×	13	7	.....	.....	.....	.....	.....	.....
Coelorhynchus quincunciatus	.....	.....	.....	13	.....	1	.....	.....	.....	.....
Coelorhynchus thompsoni	.....	.....	.....	5	.....	.....	.....	.....	.....	.....
Coelorhynchus maculatus	.....	10	.....	2	.....	.....	.....	.....	.....	.....
Coelorhynchus velifer	.....	.....	.....	107	.....	.....	.....	.....	.....	.....
Coelorhynchus sexradiatus	.....	.....	7	.....	.....	.....	.....	.....	.....	.....
Coelorhynchus notatus	.....	.....	1	.....	.....	.....	.....	.....	.....	.....
Coelorhynchus triocellatus	.....	.....	1	.....	.....	.....	.....	.....	.....	.....
Coelorhynchus dorsalis	.....	.....	.....	.....	.....	.....	2	.....	.....	.....
Coelorhynchus argus	.....	×	9	15	.....	.....	.....	.....	.....	.....
Coelorhynchus macrolepis	.....	.....	.....	57	.....	.....	.....	.....	.....	.....
Coelorhynchus cingulatus	.....	.....	.....	.....	.....	.....	1	1	.....	.....
Coelorhynchus platorhynchus	.....	7	.....	.....	.....	1	.....	.....	.....	.....
Coelorhynchus acantholepis	.....	4	.....	.....	.....	.....	.....	.....	.....	.....
Coelorhynchus carinifer	.....	.....	.....	1	.....	.....	.....	.....	.....	.....

[1] Possibly one or two others should be included.

[2] Known only from depths greater than 700 fathoms; owing to the paucity of dredge hauls at such depths these records may have little significance; the same is true, to a somewhat lesser degree, of the distribution of *Mataeocephalus adustus* and *Cetonurus robustus*.

Distributional lists of the species—Continued.

Species.	Regions.									
	1	2	3	4	5	6	7	8	9	10
Coelorhynchus smithi		3		16						
Coelorhynchus radcliffei		2		13						
Coelorhynchus weberi							1			
Coelorhynchus commutabilis		8	1	1		2				
Coelorhynchus macrorhynchus		1	2	7						
Coelorhynchus acutirostris				4						
Coelorhynchus parallelus	??)×	(?)×				3				×
Coelorhynchus spinifer		[1] 1								
Hymenocephalus gracilis				1						
Hymenocephalus longiceps		7	2	39		12	2	1	1	
Hymenocephalus longipes				25						
Hymenocephalus striatissimus		×	×	×		×	×	×	×	×
Hymenocephalus s. striatissimus						19		5	8	×
Hymenocephalus s. intergrades							25			
Hymenocephalus s. torvus				159+						
Hymenocephalus s. intergrades, nearest *s. aeger*			103							
Hymenocephalus s. aeger		72								
Hymenocephalus grimaldii		×								
Hymenocephalus nascens		39		14		1			1	
Hymenocephalus barbatulus					2					
Malacocephalus ?laevis		×								
Malacocephalus luzonensis					4		1			
Ventrifossa macronemus				3						
Ventrifossa misakia						1				×
Ventrifossa petersonii	×	(?)×								
Ventrifossa nigrodorsalis		30	2	134		4		1		
Ventrifossa divergens		14		40		2	3		1	
Ventrifossa nigromarginata		2	9	35						
Ventrifossa lucifer				14						
Lionurus proximus				3						×
Lionurus spinosus						4				×
Lionurus infranudis		1								
Lionurus evides		8								
Lionurus vittatus		×								
Lionurus richardi		×								
Lionurus pumiliceps	×	18		[2] 1		3				
Lionurus decimalis				[3] 2						
Lionurus parvipes		[1] 6								
Mataeocephalus adustus		5								
Mataeocephalus nigrescens		2		10						
Trachonurus villosus		6		38						×
Cetonurus robustus		8								×

[1] Known only from depths greater than 700 fathoms; owing to the paucity of dredge hauls at such depths these records may have little significance; the same is true, to a somewhat lesser degree, of the distribution of *Mataeocephalus adustus* and *Cetonurus robustus*.
[2] From western Luzon.
[3] From Palawan Passage.

A. THE EAST INDIAN SUBREGION.

The East Indian subregion alone contains species supposed to be identical with those of the Indian Ocean. Many of its species occur also in the Philippine subregion, and three are found in Japan—namely, *Gadomus multifilis*, *Trachonurus villosus*, and *Cetonurus robustus;* in addition to these there occurs in the East Indian subregion a species identical or closely allied with *Coelorhynchus parallelus* of eastern Luzon and Japan. *Gadomus multifilis* was also dredged off eastern Luzon, but *Cetonurus robustus* was not obtained in intermediate localities. Of these four species *Trachonurus villosus* is the only one known from the Philippine subregion; the other three East Indian forms, found also in Japan, if now connected with the Japanese population of their species, are probably so connected

along eastern Luzon. The East Indian species *Lionurus evides* is closely related only to *L. condylura* of Japan.

Only 11 species were obtained about the Sulu or Tawi Tawi Archipelago, which separates the East Indian and the Philippine subregions: 7 are found in the subregions on both sides, while 3 species[1] were not dredged elsewhere; the *Hymenocephalus striatissimus* of the Tawi Tawi region is intermediate between the East Indian *H. s. aeger* and the Philippine *H. s. torvus*, but nearest *H. s. aeger*.

B. THE PHILIPPINE SUBREGION.

This subregion includes the waters about the central Philippine Islands, north of the Tawi Tawi group, and south of west-central Luzon, and exclusive of the Pacific Ocean along the east coast of Luzon. While sharing many of its species with the East Indies, this subregion is inhabited by a number of peculiar and often singular forms: *Bathygadus sulcatus; Gadomus magnifilis; Coryphaenoides semiscaber* (representing the East Indian *C. tydemani*); three species of *Coryphaenoides*, each known only from its type dredged in the depths of the Jolo (Sulu) Sea—namely, *C. paradoxus*, *C. dubius*, and *C. camarus; Coelorhynchus quincunciatus*[2] and *thompsoni*, *C. velifer*, *C. macrolepis*, *C. carinifer*, *C. acutirostris; Hymenocephalus gracilis* (closely related to the Hawaiian *H. tenuis*); *H. longiceps; H. s. torvus* (representing *H. s. striatissimus* of Japan, Formosa, and eastern Luzon, and *H. s. aeger* of the East Indies; intergrading with *striatissimus* off northern and northwestern Luzon, and with *aeger* about the Tawi Tawi group); *Malacocephalus luzonensis*[2]; *Ventrifossa macronemus* (most nearly related to *V. misakia* of Japan and eastern Luzon); *Ventrifossa lucifer; Lionurus decimalis*.

The Philippine subregion appears to lack certain species of the East Indies, as the *Albatross* failed to obtain them during months of intensive dredging within the limits of the subregion. These species follow: *Bathygadus filamentosus*, *B. entomelas*, *Gadomus multifilis*, *Coryphaenoides asprellus*, *C. tydemani*, *C. heyningeni*, *C. aequatoris*, *C. orthogrammus*, *C.* sp. Weber, *Coelorhynchus platorhynchus* and *acantholepis*, *Hymenocephalus s. aeger*, *H. grimaldii*, *Malacocephalus ? laevis*, *Lionurus infranudis*, *L. evides*, *L. vittatus*, *L. richardi*, and *L. parvipes*, *Mataeocephalus adustus*, *Cetonurus robustus*.

In contemplating such a peculiar fauna occupying a comparatively restricted area, one is led to examine the hydrographic data of the region to determine whether the physical conditions of life may be obviously unusual. Such an examination does, in fact, indicate that the basic conditions of depth and temperature throughout this subregion are in peculiar relationship to each other. Briefly stated, the

[1] The closely related *Coelorhynchus scxradiatus, C. notatus, C. triocellatus.*
[2] One specimen also dredged off eastern Luzon.

region consists largely of a partially inclosed cup, broken up by islands to the northward, and communicating with more open bodies of water only by narrow channels, much shallower than the depths of the Jolo (Sulu) Sea, which in consequence are rendered peculiarly warm. The temperature records of depths greater than 400 fathoms vary little from 50° F., and nowhere was the temperature found to fall as low as 49°, although depths of over 1,000 fathoms were investigated.[1]

At the northern end of the Philippine subregion, in the China Sea off southern Luzon, it was found that the temperatures do not remain warm at greater depths. Here the fauna resembles, in general, that of the moderate depths to the southward, and as it contains no additional northern elements we consider it a derived portion of the Philippine fauna. It is characterized particularly by the exclusive or nearly exclusive occurrence of *Coelorhynchus velifer*, *C. macrolepis*, and *C. carinifer*.[2] Of the other species peculiar to the Philippine subregion, this northern district shares with the south only *Coelorhynchus thompsoni*, *Hymenocephalus striatissimus torvus*, and *Ventrifossa lucifer* (one specimen), fishes inhabiting the moderate depths. The remaining fishes inhabiting the China Sea off southern Luzon are not among those peculiar to the Philippine subregion.[3]

To the westward of Japan there lies a sea (Sea of Japan) which is surrounded by a rim which is not at any point depressed as much as 100 fathoms below the sea level. The straits which connect the Sea of Japan with the Pacific are thus above the normal bathymetric range of Macrouroid fishes. This Sea of Japan is geographically somewhat analogous to the area of the Philippine subregion just discussed, but faunally it differs strikingly in the fact that Macrouroid fishes "were not to be discovered in the Sea of Japan nor the Gulf of Tartary, although numerous and successful hauls of the trawl were made at the appropriate depths"; but "they were found in the Okhotsk Sea and everywhere to the eastward of the islands."[4]

c. THE EAST COAST OF MINDANAO.

The only species obtained in the Pacific Ocean off eastern Mindanao is *Hymenocephalus barbatulus*, unknown elsewhere, but closely related to *H. papyraceus* of Japan.

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[1] An unusually heavy degree of parasitism noted among these fishes is probably to be correlated with the lack of currents in this comparatively warm inclosed sea.

[2] The distribution of *Malacocephalus luzonensis* differs from any of the others: it is known from three specimens from southern Luzon, one from western Luzon (taken with intergrades between *Hymenocephalus s. striatissimus* and *H. s. aeger*), and one from eastern Luzon.

[3] Two species, known also from the East Indies and from off eastern Luzon, are known from the Philippine subregion by a single specimen: A specimen of *Gadomus introniger* was dredged off southern Luzon, and one of *Lionurus pumiliceps* off western Luzon.

[4] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 135.

D. THE EAST COAST OF LUZON.

In the Philippine subregion, already discussed, we find among 40 species present only two species which occur also in Japan. On the east coast of Luzon, however, out of a total of but 20 species known to inhabit that region 5 species are also found in Japan. Of these five species but one or two[1] occur in the East Indies and none belong to the fauna of the Philippine subregion. The typical Japanese subspecies of *Hymenocephalus striatissimus* ranges southward to eastern Luzon, but is exclusively represented in the Philippine subregion by *H. s. torvus*. The most remarkable of all Macrouroid fishes, *Macrouroides inflaticeps*, which is known only from the type dredged off eastern Luzon, finds its sole ally in *Squalogadus modificatus* of Japan. The four species which range from the East Indies as far north as northern Luzon occur on both coasts of that island. Of the 10 remaining species of eastern Luzon, 6 are found also both in the Philippine and the East Indian subregions, while one specimen each of 4 species were obtained, two of which are characteristic of the Philippine subregion, one is characteristic of the East Indian subregion, and a fourth is known elsewhere only from northern Luzon.

E. NORTHERN AND NORTHWESTERN LUZON.

The seven species known from this region show the following relationships:

1. *Coryphaenoides microps*, known also from southeastern Luzon.

2. *Coelorhynchus dorsalis*, unknown elsewhere, but representing the *C. notatus* group of the Philippine and East Indian subregions.

3. *Coelorhynchus cingulatus*, a very distinct species known also from Formosa.

4. *Coelorhynchus weberi*, more closely related to *C. productus* and *C. anatirostris* of Japan than to any of the numerous species occurring to the southward.

5. *Hymenocephalus striatissimus*, intergrades between *H. s. striatissimus* of Japan, Formosa, and eastern Luzon, and *H. s. torvus* of the Philippine subregion.[2]

6 and 7. *Hymenocephalus longiceps* and *Ventrifossa divergens*, known throughout the region both to the northward and the southward.

F. FORMOSA.

In addition to *Coelorhynchus cingulatus* and to *Hymenocephalus s. striatissimus*, discussed in the preceding section, there are known from about Formosa but two species, *Hymenocephalus longiceps* and *Ventrifossa nigrodorsalis*, species of wide range to the southward.

[1] *Bathygadus multifilis* and perhaps *Coelorhynchus parallelus*.

[2] One specimen of *Malacocephalus luzonensis* was obtained off western Luzon within the range of these intergrades.

G. CHINA SEA IN THE VICINITY OF HONGKONG.

Three of the species obtained here—namely *Hymenocephalus longiceps*, *H. nascens* and *Ventrifossa nigrodorsalis*, occur throughout the East Indian-Philippine region, while the fourth, *Hymenocephalus striatissimus*, belongs to the typical subspecies found also off Japan, Formosa, and eastern Luzon.

IV. SYSTEMATIC DESCRIPTIONS.

Family CORYPHAENOIDIDAE.

Subfamily BATHYGADINAE.

Genus BATHYGADUS Günther.

A detailed study of the various species of *Bathygadus* has led us to conclude that all of the described species are valid,[1] and further, that, in so far as known, they are of localized distribution. In addition to the two species we are now describing, we have examined all of the twelve species hitherto known with the exception of two: *B. cottoides* and *B. melanobranchus*.

The species of *Bathygadus* form a well-graded series, by which those with excessively wide and cavernous heads are connected with those having comparatively firm heads. At the two extremes of this series stand *B. bowersi* and *B. macrops*. These two species are of very dissimilar appearance, but their reference to the same genus can be justified by the existence of such intermediate species as *B. filamentosus*.

An attempt has been made in the construction of the following key to indicate the mutual relationships of the species.

KEY TO THE KNOWN SPECIES OF THE GENUS BATHYGADUS.

a[1]. Orbit[2] decidedly less than two-thirds the interorbital width; head excessively wide and cavernous; scales on mandible in a single series[3]; no barbel ..... (BATHYGADUS).

b[1]. First dorsal, pectoral and ventral fins without long filamentous rays, all being shorter than the head.

c[1]. Interorbital width contained less than 3 times in length of head; color blackish ..... *bowersi*.

c[2]. Interorbital width contained more than 3 times in length of head.

d[1]. Ventral fins inserted in advance of pectorals; the distance from anus to base of ventrals greater than postorbital length of head;[4] color blackish brown.

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[1] With the single exception of *B. dubiosus* Weber, which seems to be identical with *B. filamentosus*.

[2] Extreme length between orbital rim on each side as distinguished from diameter of eye.

[3] Not verified in *B. cottoides*.

[4] Verified in *B. cottoides* from Günther's figure.

e^1. Gill-rakers 6+17; eye half length of snout or of interorbital space ——— *cottoides.*

e^2. Gill-rakers 5 or 6+19 to 22; eye more than half length of snout or of interorbital space ——— *spongiceps.*

d^2. Insertion of ventral fins below that of pectorals; distance from anus to base of ventral equal to the postorbital length of the head; color light ——— *favosus.*

b^2. First dorsal, pectoral and ventral fins each with a filamentous ray longer than the head; color lighter than in *B. bowersi* or *B. cottoides* ——— *antrodes.*

a^2. Orbit more than two-thirds interorbital width (orbit 1.4 to 1.6 in interorbital in *B. filamentosus*); head only moderately wide and cavernous; scales on mandible in 1½ or 2 series ——— (MELANOBRANCHUS).

f^1. First dorsal, pectoral and ventral fins each with a filamentous ray longer than the head.

g^1. Barbel not present; orbit 1.4 to 1.6 in interorbital width; about 20 gill-rakers on lower limb of outer arch—*filamentosus.*

g^2. Barbel small, but evident; orbit 1.0 in interorbital width; 35 gill-rakers on lower limb of outer arch ——— *micronema.*

f^2. Fins without long filaments.

h^1. Barbel absent.

i^1. Ventral with 10 rays; 19 gill-rakers on lower limb of outer arch; pseudobranchiae present; interorbital little wider than orbit, 3.7 in head; snout scarcely longer than orbit; branchial cavity wholly black ——— *entomelas.*

i^2. Ventral with 8 or 9 rays.

j^1. Orbit shorter than snout.

k^1. 19 to 21 gill-rakers on lower limb of outer arch; pseudobranchiae present in adult; interorbital 4 in head; branchial cavity wholly black ——— *furvescens.*

k^2. 16 gill-rakers on lower limb of outer arch; pseudobranchiae absent in adult; interorbital 3.43 in head; color much lighter, the posterior margins of the opercular and gill membranes irregularly lighter or whitish ——— *nipponicus.*

j^2. Orbit decidedly longer than snout, about equal to interorbital width ——— *melanobranchus.*

h^2. A small barbel present.

l^1. Interorbital wider than eye ——— *garretti.*

l^2. Interorbital much narrower than eye.

m^1. Inner shagreen-like portion of premaxillary band of teeth forming only a narrow border to the band; orbit 4 in head; ground color chocolate; iris dark; ventrals with 9 rays; barbel tubercular ——— *sulcatus.*

m^2. Inner shagreen-like portion of premaxillary band of teeth about half as wide as the entire band; orbit very large, 2¾ to 3 in head; ground color silvery or gray, including iris; ventrals with 8 rays; barbel slender ——— *macrops*[1]

[1] Among the species of *Bathygadus, B. macrops* most closely approaches the genus *Gadomus* as defined by us.

Subgenus BATHYGADUS Günther.

1. BATHYGADUS SPONGICEPS, new species.

Type-specimen.—Cat. No. 78210, U.S.N.M.: 390 mm. in total length, 105 mm. long to anus; dredged at *Albatross* station 5582 in the vicinity of Darvel Bay, Borneo.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5274	China Sea, off southern Luzon	525	41.3	2
[1] 5460	Off southeast coast of Luzon	565		2
5467	....do	480		1
5582	Off northeastern Borneo	890	38.3	1
5648	Buton Strait, near Celebes	559	39.2	1

[1] *B. jurvescens* was also dredged at this station.

The body is deep and sharply compressed, thin posteriorly; the width of the body across the pectoral bases is two-fifths its greatest depth. The head is broad and cavernous; its membrane-bones are thin and papery. The dorsal contour is arched behind the occiput, but concave from the occiput forward to the tip of the premaxillary spine, which enters conspicuously into the profile; the ventral contour is angulated more sharply than usual at the posterior end of the mandible. The sides of the head are subvertical. The orbit is rather small, its length being contained five times in the head, or 1.8 (1.7 to 1.8 in paratypes) times in the least interorbital width, which is as great as, or slightly greater than, the length of the snout, and is contained slightly more than three times in the head. The least width of the suborbital space is contained 1.3 (1.3 to 1.5) times in the length of the orbit. The opercle, as usual, divides posteriorly into two branches, the upper of which ends in a flat and weak spine; the lower branch, also weak, extends across the subopercle to an acute tip. The lower margin of the interopercle is arched upward more strongly than in the related Japanese species, *B. antrodes*. The posterior angle of the interopercle is produced backward in the form of an acutely rounded lobe, which is longer and narrower than that of *B. antrodes;* the tip of this flap is visible behind the rounded angle of the preopercle.

The mouth is oblique and large; the upper jaw extends to the vertical from the hind margin of the orbit, and is contained 1.8 (to 1.9) times in the head. The teeth are rather coarse and irregularly placed in the premaxillary band, which is margined within by a definite, narrow, parrallel-sided area of shagreen-like teeth, extending

forward almost to the front of the premaxillaries. No trace of a mandibular barbel can be detected on any of the specimens. Small inclosed pseudobranchiae are present on all specimens, and are located, as in the other species, beside a deep conic pit. The gill rakers are always denticulate along their inner edges, but are variable in width and in length; the longest one, near the angle of the first gill arch, is contained 1.8 (1.2 to 1.6) times in the orbit; the number of gill-rakers is 6+20 on the left, and 6+22 on the right side of the type (6 or 5+19 to 21 in paratypes). Four full gills are present, the last of which is short, and followed by a slit about half as wide as the interorbital space. The branchial aperture is continued forward almost to the vertical from the anterior orbital margin. Seven branchiostegals. As in *B. antrodes*, the scapular

FIG. 1.—BATHYGADUS SPONGICEPS. TYPE.

foramen, though encroaching entirely upon the substance of the hypercoracoid, is in contact with the suture separating that bone from the hypocoracoid.

The scales which separate the lateral line series from the front of the second dorsal fin are arranged in six horizontal series. Several much enlarged scales or scale-like bones are present in the sensory canal above the gill openings. The shoulder girdle is scaleless beneath the opercles.

The first dorsal spine is soft and concealed, but is slender, sharp, and about one-fifth as long as the orbit; the smooth second dorsal spine is contained 1.6 times in the head; the second pectoral and the outermost ventral rays are likewise scarcely strengthened or produced. In this respect *B. spongiceps* differs notably from *B. antrodes*, in which the three rays are strengthened and greatly lengthened. The base of the ventral fin is anterior to the base of the pectoral, which is nearly in line with the origin of the first dorsal. The distance from the center of the anus to the base of the outer ventral ray is contained 1.6 (to 1.8) times in the head.

The pyloric caeca were counted in three paratypes. In one there were 21, longer than the orbit, but shorter than the interorbital; in another, 16, about as long as the orbit; in a third specimen, 17, only two-thirds as long as the orbit.

The color is very dark, the head, belly, and fins being blackish. The lining of the buccal cavity is blackish; that of the branchial and abdominal cavities wholly black. The wall of the stomach and the mesenteries are black, while the intestines and pyloric caeca are without pigment.

B. spongiceps differs widely from *B. filamentosus*, *B. micronema*,[1] *B. nipponicus*,[2] *B. entomelas*, *B. furvescens*, *B. melanobranchus*,[3] *B. garretti*,[4] *B. sulcatus*, and *B. macrops*,[5] in the much wider and more cavernous head, correlated with a smaller size of eye, and other characters. It may readily be distinguished from *B. antrodes*[6] by the lack of filamentous rays, by the different form of the interopercular margin, and by the decidedly blacker coloration. From *B. favosus*[7] of the western Atlantic, it differs in the coarser dentition, in the more advanced position of the ventral fins, and in the very much darker color. It seems to differ from *B. cottoides*,[8] described by Günther from near New Zealand and the Kermadec Islands (a species insufficiently described) in the more numerous gill-rakers (5 or 6+19 to 22, instead of 6+17), and in the larger eye, the length of which is constantly somewhat more than half the length of the snout or the width of the interorbital space. *B. spongiceps* is closely related also to *B. bowersi*,[9] an Hawaiian species, from which it differs in the lesser width of the interorbital space, which is contained more, instead of less, than three times in the head; in the lower position of the scapular foramen, and in dentition, the inner shagreen-like portion of the premaxillary band not being expanded posteriorly, but forming throughout only a narrow margin to the main outer portion of the band.

[1] Gilbert, Bull. U. S. Fish Comm., 1903 (1905), sec. 2, p. 661, fig. 258.

[2] Jordan and Gilbert, Bull. U. S. Fish Comm., 1902 (1904), p. 605, text fig.

[3] Vaillant, Exp. Sci. *Trav. Talisman*, 1888, p. 206, pl. 18, fig. 1; Collett, Poissons de *L'Hirondelle*, 1896, p. 88.

[4] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 151, pl. 8, fig. 1.

[5] Goode and Bean, Oceanic Ichthyology, 1895, p. 423.

[6] Jordan and Gilbert, Bull. U. S. Fish Comm., 1902 (1904), p. 606, pl. 4, fig. 1; Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 149.

[7] Goode and Bean, Bull. Mus. Comp. Zool., vol. 12, pt. 5, 1886, p. 160; Oceanic Ichthyology, 1895, p. 420, fig. 352.

[8] Günther, Ann. Mag. Nat. Hist., vol. 2, 1878, p. 23; *Challenger* Reports, vol. 22, 1887, p. 154.

[9] Gilbert, Bull. U. S. Fish Comm., 1903 (1905), sec. 2, p. 659, fig. 257.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.		
Albatross station	5582	5648	5467	5274
Total length in mm	390	307+	285+	232
Length to anus in mm	105	90	93	66
Length of head	61	66	.....	68
Length of orbit	12	12.5	.....	13
Width of interorbital	21	22	.....	23
Width of suborbital	8	9	.....	10
Orbit to preopercle	31	33	30.5	34
Length of snout	20	20.5	.....	20
Length of upper jaw	34.5	37	.....	38
Depth of body	44	[1] 50	.....	[1] 50
Width of body	21	20	20.5	20
Anus to ventral	38	39	41	37
Ventral to end of pectoral arch	28	29	29	.....
Height of second dorsal spine	39	.....	41	.....
Length of first dorsal base	20.5	20.5	18	20
Length of first pectoral ray	11.5	10.5	11	11
Length of second pectoral ray	.....	31.5	.....	.....
Scales, above lateral line	6	[2]	[2]	[2]
Soft rays, first dorsal	9	8	8	8
Ventral rays	9–9	9–9	9–9	9–8
Pectoral rays	19–17	18–17	15–15	.....
Gill-rakers, outer arch (left)	6+20	6+20	6+19	5+21
Gill-rakers, outer arch (right)	6+22	6+19	6+19	6+20
Length, gill-rakers	7	8	8	9.5

[1] Approximate.

[2] Probably 6.

(*spongiceps*, in reference to the spongy nature of the head.)

Subgenus MELANOBRANCHUS Regan.

2. BATHYGADUS FILAMENTOSUS (Smith and Radcliffe).

Regania filamentosa SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 107, pl. 22, fig. 2.

Bathygadus dubiosus WEBER, Die Fische der *Siboga*-Expedition, May, 1913, p. 173, pl. 5, fig. 5.

Bathygadus filamentosus WEBER, Die Fische der *Siboga*-Expedition, p. 672.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			F°.	
5587	Off east [1] coast of British North Borneo	415	42.3	2
5619	Molucca Passage	435	.....	1
5650	Gulf of Boni, East Indies	540	40.1	1

[1] The type station was wrongly located in the original description; it is off the east, not the west, coast of Borneo.

In form, in the breadth and softness of the head, in the size of the eye, in the development of the sensory canal system, and in the strength of the opercular spines, this species occupies a position intermediate between the species of the *B. cottoides* type, on the one hand, and those species with comparatively firm heads and large eyes on the other hand.

Our measurement of the interorbital differs a little from that given in the original description. As we measure, the orbit is con-

tained 1.5 times in the least interorbital width, which is contained three times in the head.

The lower margin of the interopercle is but slightly concave. The flap at its posteroventral angle is short and blunt, only its tip being visible behind the semicircular margin of the preopercle.

The inner shagreen-like portion of the premaxillary band of teeth extends only along the posterior half of the band. The teeth in the narrow mandibular band are of unequal size.

Seven branchiostegal rays. The small pseudobranchial filaments are concealed beneath the skin.

A single main series of oval, imbricate scales extends along each mandibular ramus, but this series is flanked along its outer side by a few small scales. The lateral line on the tail runs below the middle of the depth, as in other species.

The pyloric caeca, 30 in number, are about two-thirds as long as the orbit.

Lining of the buccal, branchial, and abdominal cavities wholly black.

B. filamentosus is perhaps most closely related to *B. antrodes* of Japan, differing from that species, however, in the narrower, firmer head, larger eye, longer fin filaments, more numerous pyloric caeca, etc. It is probably related also to *B. micronema*, an Hawaiian species, but differs, in addition to the characteristics mentioned by Radcliffe, in the fewer gill-rakers.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.		
Albatross station	5587	5587	5650	5619
Total length in mm	[1] 242	[1] 173	230	[1] 181
Length to anus in mm	72	48	.....	54
Length of head	63	70	.....	.....
Length of orbit	15	15	.....	.....
Width of interorbital	22	24	.....	.....
Width of suborbital	10	10	.....	.....
Orbit to preopercle	31	33	.....	.....
Length of snout	20	22	.....	.....
Length of upper jaw	39	40	.....	.....
Depth of body	43	.....	.....	.....
Anus to anal	7.5	10	.....	.....
Anus to ventral	36.5	.....	.....	.....
Ventral to end of pectoral girdle	30	.....	.....	.....
Length of first dorsal base	16	17	.....	.....
Length of first pectoral ray	11	.....	.....	.....
Length of second pectoral ray	121	.....	.....	.....
Length of third pectoral ray	43	.....	.....	.....
Length of outer ventral ray	119+	.....	.....	.....
Length of second ventral ray	31	.....	.....	.....
Scales above lateral line	7	.....	7	7
Soft rays, first dorsal	8	9	8	.....
Ventral rays	8	8	8	8
Pectoral rays	15	15	.....	.....
Gill-rakers, left side	6+20	6+19	.....	6+20
Gill-rakers, right side	.....	6+20	.....	.....

[1] A pseudocaudal developed.

(*filamentosus*, in reference to the long filaments.)

3. BATHYGADUS ENTOMELAS, new species.

Type-specimen.—Cat. No. 78211, U.S.N.M., a female specimen, 220 mm. long (a pseudocaudal developed), from *Albatross* station 5619, in Molucca Passage, East Indies; depth, 435 fathoms; dredged with a specimen of *B. filamentosus.*

The body is more slender and less compressed than in *B. spongiceps*, the width over the pectoral being more than half the greatest depth.

The head, though wide and cavernous, is much narrower and less spongy than in the species of the subgenus *Bathygadus.* The dorsal contour, not strongly arched behind the occiput, is straight from that point forward to the tip of the premaxillary spine; the evenly curved

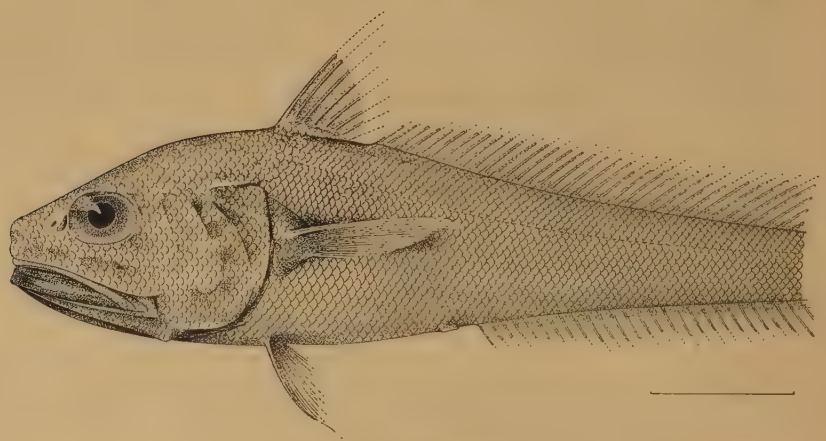

FIG. 2.—BATHYGADUS ENTOMELAS. TYPE.

ventral contour is less strongly angulated than in the species of the *B. cottoides* type. The orbit is larger than in the preceding species; its length is contained 4 times in the head, or 1.1 times in the least interorbital width, which is equal to the length of the snout; interorbital 3.7 in head. The least suborbital width is contained 2.4 in the interorbital. The two limbs of the opercle end in very weak spines, the upper of which is flat; the lower, slender. The interopercle is formed much as in *B. antrodes*, having the lower margin concave, and the bluntly rounded posterior flap just visible behind the preopercular margin. The mouth is only moderately oblique, more nearly horizontal than that of *B. cottoides* and its allies. The upper jaw extends slightly beyond the vertical from the hind orbital margin, its length being contained 1.8 times in the head. The teeth, similar to those of *B. spongiceps*, are coarser than those of *B. furvescens;* the mandibular band, which is about one-third as wide as the premaxillary band, is composed of but two or three irregular rows of

teeth; the premaxillary band as usual consists of two portions—an outer one, with rather small teeth, which become decidedly smaller posteriorly; and an inner, shagreen-like portion, which extends along the entire inner length of the band, becoming widest below the front half of the eye, where its width is 0.03 of the length to the anus; the band narrows abruptly on its posterior third. No trace can be detected of a mandibular barbel. The pseudobranchiae, which form a series one-fourth as long as the orbit, are located beside the usual conic pit. The slit behind the fourth gill-arch is only half as long as the orbit. Branchiostegals, 7; gill-rakers, 5+20 (left) or 5+21 (right), denticulate on their inner margins; the longest gill-raker is half as long as the orbit. The branchial aperture is continued forward ventrally to a vertical crossing the orbit before the pupil. The scapular foramen lies wholly within the hypercoracoid, but is in contact with the suture between that bone and the hypocoracoid.

The scales are in eight series from the origin of the second dorsal to but not including the lateral line series; the scales are thin and cycloid; they are in two series on the mandible. The shoulder girdle is covered by a naked membrane beneath the opercles.

Fin-rays—first dorsal, II, 8; ventrals, 10; pectorals, 17 and 18. The first dorsal spine is slender and concealed; neither the second dorsal spine nor any of the pectoral rays are strengthened or produced. The outer ventral ray probably failed to reach the anus. The base of the ventral is but little anterior to the origin of the dorsal and the insertion of the pectoral.

Pyloric caeca, thirty-five, shorter than the orbit.

The color in alcohol is light brown, becoming blackish on the belly and on the jaws and the gular and branchiostegal membranes. The ventral fins are blackish; all the other fins are dusky. The lining of the buccal cavity is blackish; that of the branchial and abdominal cavities wholly black; the walls of the stomach are black, but the intestines and the pyloric caeca are pale.

The relationships of this species are indicated in the preceding key. It is apparently related, though not very closely, to the two Japanese species of this subgenus—*B. nipponicus* and *B. garretti*. It differs from the Atlantic *B. melanobranchus* in the more numerous ventral rays, smaller eye, and other characters. It is closely related also to *B. furvescens*, but differs from that species in numerous details: the ventral rays are more numerous (10, instead of 8 or 9); 8 instead of 7 series of scales separate the front of the second dorsal from the lateral line; the color is much lighter, especially on the fins; the walls of the intestines are not pigmented; the body is less strongly compressed, the width of the pectoral bases being contained less than, instead of more than, twice in the depth;

the head is of firmer texture; the distance between the head and the anus in *B. entomelas* is equal to the length of the head behind the anterior nostril, but in *B. furvescens* is equal to the length of the head behind the middle of the eye; the teeth are coarser and in narrower bands on the jaws; the scapular foramen pierces the shoulder girdle at a lower point, being in contact with the suture between the hypercoracoid and the hypocoracoid; and, finally, the orbit is noticeably larger, although the type has been compared, in the preparation of the following table, with both smaller and larger Philippine specimens of *B. furvescens.*

Table showing size of orbit in Bathygadus entomelas and B. furvescens.

	entomelas.	*furvescens.*
Orbit in head	4.0	4.5 to 5.0
Orbit in snout	1.1	1.2 to 1.35
Orbit in interorbital	1.1	1.2
Orbit in postorbital	1.9	2.2 to 2.6

Measurements in hundredths of length to anus (84 mm.).—Length of head, 59; length of orbit, 16; least distance between orbits, 17; least suborbital width, 7; distance between orbit and preopercle, 29; length of snout, 18; length of upper jaw, 34; depth of body, 41; width of body over pectoral bases, 26; distance from origin of anal to center of anus, 7; from anus to base of outer ray, 39; from ventral fin to anteroventral end of pectoral girdle, 27; length of first dorsal base, 17; length of longest gill-rakers, 8.

Only the type-specimen is known to us.

(*entomelas*, in reference to the wholly black branchial cavity.)

4. BATHYGADUS FURVESCENS Alcock.

Bathygadus furvescens Alcock, Journ. Asiatic Soc. Bengal, vol. 43, pt. 2, 1894, p. 128; Illustrations of the Zoology of the *Investigator*, Fishes, pl. 16, fig. 1, 1895; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 121.

Bathygadus melanobranchus Brauer, Die Tiefsee-Fische, 1906, p. 272.—Weber, Die Fische der *Siboga*-Expedition, May, 1913, p. 112.

Contrary to the suggestion of Alcock and to the opinion of Brauer, this species appears to be distinct from the Atlantic *B. melanobranchus* Vaillant,[1] having a decidedly smaller eye, according to the measurements of Vaillant, Collett, Alcock, and Brauer. Our study of the material which is here referred to *B. furvescens* strongly confirms the view that the two species are quite distinct.

For the purpose of more accurate comparison we present a description of our Philippine specimens, which were collected at the following stations:

[1] Vaillant, Exp. Sci. *Trav. Talisman*, 1888, p. 206, pl. 18, fig. 1; Collett, Poissons de *L'Hirondelle*, 1896, p. 88.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
[1] 5460	East coast of Luzon	565		1
5495	Between Leyte and Mindanao	976	52.3	1
5515	Off northern Mindanao	[2]		1
5526	Between Siquijor and Bohol Islands	805	52.3	1
5601	Gulf of Tomini, Celebes	765		1

[1] *B. spongiceps* was also dredged at this station. [2] About 700.

In the form and the texture of the head this species occupies a position intermediate between *B. entomelas* and *B. filamentosus*. The body is compressed more strongly than in *B. entomelas*, but less strongly than in *B. filamentosus*, the width across the pectoral bases being contained about $2\frac{1}{4}$ times in the greatest depth of the body. The length of the orbit is contained from 4.5 to 5.0 [1] times in the head; 2.2 to 2.6 times in the length of the head behind the orbit; 1.2 to 1.35 times in the snout; and 1.2 times in the interorbital width. The length of the snout and the least interorbital width are each contained from 3.6 to 3.8 times in the head. The least suborbital width enters 2.2 to 2.3 times into the interorbital. The opercle ends posteriorly in two weak spines, only the tips of which are exposed. The form of the interopercle is like that of *B. entomelas;* its posterior flap is just visible behind the preopercle. Length of upper jaw, 1.8. The teeth are finer than usual in *Bathygadus;* the premaxillary band is 0.2 as wide as the orbit; its inner shagreen-like portion is narrow and not strongly differentiated from the outer portion; the villiform teeth of the mandible form a band nearly half as wide as the premaxillary band (the dentition is quite different in *B. entomelas*). The barbel is absent. Pseudobranchial filaments are constantly present; the slit behind the fourth gill-arch is shorter than the orbit. The scapular foramen pierces the hypercoracoid about its own diameter above the suture between that bone and the hypocoracoid (determined in three specimens; both sides examined in one).

Seven series of thin and deciduous scales occupy the space between the origin of the second dorsal and the lateral line series. There are two series on the mandible, but none on the face of the shoulder girdle beneath the opercles.

None of the fins are greatly produced or strengthened. The ventral fin is inserted but little before the base of the pectoral or the origin of the dorsal.

Twenty pyloric caeca, two-thirds as long as the orbit, were counted in one specimen.

The coloration is darker than in *B. entomelas*. The fins are blackish; the buccal, branchial, and abdominal cavities are wholly lined

[1] In the largest specimen.

with black; the walls of the stomach are black, and those of the intestines are also pigmented.

Table of measurements in hundredths of length to anus.

Albatross station	5460	5515	5526	5495	5601
Total length in mm	----	271	235	203	85+
Length to anus in mm	145	72	62	51	30
Length of head	----	63	64	65	66
Length of orbit	12	15	15	16	15
Width of interorbital	16	18	18	19	20
Width of suborbital	----	8	8	9	----
Orbit to preopercle	28	31	32.5	31	----
Length of snout	18	17	18	19	----
Length of upper jaw	33.5	36	37	37	36
Depth of body	----	45	47	46	----
Width of body	----	24	23	21	----
Anus to anal	7.5	9	11	11	9
Anus to ventral	42	38	37	39	33
Ventral to anteroventral end, pectoral girdle	23.5	29	28	29	31
Height of second dorsal spine	----	31	----	----	----
Length of first dorsal base	19	18	19	21	----
Length of first pectoral ray	10	----	----	----	----
Length of second pectoral ray	35+	40+	----	40+	----
Length of outer ventral ray	----	42+	----	40	----
Length of gill-rakers	8.5	9	10	----	----
Number of gill-rakers, left	x+19	6+20	6+20	----	----
Number of gill-rakers, right	6+19	6+19	6+20	----	----
Soft rays, first dorsal	8	8	7	9	----
Pectoral rays	20	15	16	----	----
Ventral rays (both sides)	9–9	9–9	9–9	9–9	----

(*furvescens*, in reference to the dark color).

5. BATHYGADUS SULCATUS (Smith and Radcliffe).

Regania sulcata Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 108, text fig. 1 and pl. 22, fig. 3.

List of stations.

Albatross station	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5423[1]	Near Cagayan Island, Jolo Sea	508	49.8	1
5219	Between Marinduque and Luzon	530	50.8	1
5423	Near Cagayan Island, Jolo Sea	508	49.8	4
5424	....do	340	50.4	2
5510	Off northern Mindanao	423	53.0	2
5527	Between Siquijor and Bohol	392	53.3	2
5528	....do	439	53.3	1
5529	....do	441	53.0	2
Lost				1

[1] Type.

A few additions to the original description have been compiled.

Pseudobranchiae are present, but concealed beneath the skin.

The inner shagreen-like portion of the premaxillary band of teeth is very definite, and forms a narrow margin along the entire band in the smaller specimens, but disappears anteriorly in the larger type; both portions of the band are widest at the end of the second third of its length; the teeth forming the outer portion are rather coarse, and expanded distally ("arrow-shaped"), but they become much smaller and more crowded posteriorly.

The form of the interopercle distinguishes *B. sulcatus* from the other Philippine species of the genus; the lower margin of that

bone, along its posterior half, even along the posterior flap, is almost straight. The branchial aperture extends forward to below the middle of the eye, where the gill-membranes form a narrow fold across the isthmus.

The scales are in two series along the mandible.

Thirty-five pyloric caeca were counted in one specimen; they are very short, being only two-fifths as long as the orbit.

The parietal peritoneum is black.

The three most anterior gill-rakers are unusually small, and were not included in the count in the type-description: there are 6+18 or 19 in the type-specimen, instead of 5+16, as given by Radcliffe.

Table of measurements in hundredths of length to anus.

	Type.				
Albatross station	5423	5424	(*unknown*)	5510	5513
Total length in mm	440	[1]323	300	[1] 172	[2] 108+
Length to anus in mm	156	98	93	54	35
Length of head	58	58	58	63	62
Length of orbit	15.5	16.5	17	18	17.5
Width of interorbital	12.5	14	13	17	16.5
Width of suborbital	6	7	7	8	8
Orbit to preopercle	27	28	28	29	.....
Length of snout	16	16.5	16	18	.....
Length of upper jaw	32.5	32.5	33	38	37
Depth of body	38	41	38	42	.....
Width of body	25	26	21	22	.....
Anus to anal	9	7	8	9	10
Anus to ventral	39.5	39.5	39.5	37	.....
Ventral to end of pectoral arch	27.5	28	28.5	27	27
Height of second dorsal spine	.....	.....	19	.....	.....
Length of first dorsal base	17	16	17	19	18
Length of first pectoral ray	7	9	8	.....	.....
Length of second pectoral ray	.....	54.5	.....	57	.....
Length of third pectoral ray	.....	40	.....	.....	.....
Length of outer ventral ray	.....	51	45	.....	.....
Length of gill-rakers	8	9	9	11	.....
Scales:					
Above lateral line	9	9	9	.....	8
Below lateral line	20	21	21	.....	.....
Soft rays, first dorsal	10	8	9	9	9
Ventral rays (both sides)	9–10	9–9	9–9	10–9	10–10
Pectoral rays	17	16	15	.....	.....
Gill-rakers:					
Left	5+19	6+18	.....	5+18	.....
Right	5+18	5+18	5+18	5+19	.....

[1] A small pseudocaudal developed.

[2] The smallest specimen procured.

(*sulcatus*, furrowed.)

Genus GADOMUS Regan.

This group, as recently defined by us,[1] contains about 10 species which have been greatly confused. The seven described species are probably all valid, and they appear to follow the species of *Bathygadus* and other Macrouroid genera in their localized distribution. The western Atlantic species, *G. longifilis*, has been recorded from the eastern Atlantic by Vaillant[2] and Collett,[3] but the descriptions

[1] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 139, 148.

[2] Vaillant, Exp. Sci. *Travailleur et Talisman*, Poiss., 1888, p. 218, pl. 23, fig. 1.

[3] Collett, Poissons de *L'Hirondelle*, 1896, p. 91.

of these authors indicate that they have had another species, in which the interorbital is nearly as wide as the orbit. In addition Vaillant counted 9 ventral rays ("I, 8") and Collett 7+27 gill-rakers on the outer arch, while *G. longifilis* has but 8 ventral rays, and 30 to 35 gill-rakers below the angle of the outer arch. Alcock's,[1] Brauer's[2] and Weber's[3] records of this species from the Indian Ocean and East Indian Islands seem to be all erroneous. The species of these authors are distinguished from the true *longifilis* by their wider interorbital space and more numerous pyloric caeca.

The number of pyloric caeca in the species of Gadomus[4], with the number of specimens counted.

G. longifilis (Goode and Bean)	8	(one).
G. sp. (Hawaiian Islands)[5]	12	(one).
G. melanopterus	15	(one).
G. multifilis (Philippine Islands)	12	(one).
G. multifilis (Japan)	16	(one).
"*Bathygadus longifilis*" of Alcock	20	(one?)
"*Bathygadus longifilis*" of Brauer	15 to 22	(two).
G. magnifilis	24 to 29	(two)
G. introniger	35 to 52	(several).
G. denticulatus	61 to 75	(three).
G. colletti	95	(one),

The number of pyloric caeca occurring in the different species of *Gadomus* thus form a very striking series, in which the number gradually becomes smaller as one passes from the species with the firmest, narrowest heads and the fewest gill-rakers, to those of the more bathybial types, with contrasting characters.

ANALYTICAL KEY TO THE SPECIES OF GADOMUS.

a^1. Fins without long filaments; pectoral broad, with 25 rays; teeth excessively minute; interorbital much narrower than orbit.
arcuatus (western Atlantic).

a^2. Fins with long filamentous rays; pectoral narrower, with 15 to 22 rays.

b^1. Gill-rakers on lower limb of outer arch, 17 to 25, blunt at their tips (undescribed in *G. dispar*, a species not closely related to those of groups b^2 and b^3).

c^1. Interorbital 2 in "eye" *dispar* (Eastern Atlantic).

c^2. Interorbital 1.57 to 1.8 in orbit; gill-cavity with a whitish band on opercular margin; gular membrane light brown.

d^1. Teeth so excessively minute and crowded as to form an even shagreen-like surface, on which the individual teeth cannot be distinguished by the unaided eye; filamentous rays shorter, the dorsal spine less than twice as long as head; pyloric caeca 61 to 95.

e^1. Band of teeth in upper jaw little expanded posteriorly, its greatest width half that of bony suborbital region; color lighter; head firmer; pyloric caeca 95 *colletti* (Japan).

[1] Alcock, Ann. Mag. Nat. Hist., ser. 6, vol. 6, 1890, p. 302; and ser. 6, vol. 8, 1891, p. 123; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 120.

[2] Brauer, Die Tiefsee-fische, 1906, p. 270, pl. 12, fig. 7.

[3] Weber, Die Fische der *Siboga*-Expedition, 1913, p. 172.

[4] All of the counts were made by us, excepting those credited to Alcock and Brauer.

[5] Gilbert, Bull. U. S. Fish Comm., 1903 (1905), sec. 2, p. 659.

c^2. Band of teeth in upper jaw expanded posteriorly, its greatest width being contained from 1¼ to 1⅔ times in the least width of bony suborbital region; color darker; head more cavernous; pyloric caeca 61 to 75 ..... *denticulatus* (East Indies).

d^2. Teeth small, but readily distinguishable by the unaided eye; band of teeth in the upper jaw narrow, its greatest width 2.0 to 2.4 in bony suborbital region; filamentous rays longer, the dorsal spine being more than twice as long as the head; pyloric caeca 24 to 29 ..... *magnifilis* (Jolo Sea, Philippines).

c^3. Interorbital 1.0 to 1.23 in orbit; gill-cavity wholly black, as in the following species; gular membrane black; ventral fin with 8 rays. *introniger* (East Indies).

b^3. Gill-rakers on lower limb of outer arch 26 or 27, long and pointed; pectoral rays 17 to 20; interorbital space nearly as wide as the orbit; pyloric caeca 12 or more; gular membrane black; teeth readily distinguished by unaided eye.

f^1. Ventral rays constantly 8; pseudobranchiae present in specimens nearly as large as the type of *melanopterus;* scapular foramen on suture between hypercoracoid and hypocoracoid. *multifilis* (East Indies to Japan).

f^2. Ventrals 9-rayed in type;[1] no pseudobranchiae in type; scapular foramen wholly within the hypercoracoid. *melanopterus* (Hawaiian Islands).

b^3. Gill-rakers on lower limb of outer arch 30 to 35 (30 to 33 counted by us, 35 given in original description); gill-rakers long and slender, sharply pointed; pectoral rays 15 (13 given in original description); interorbital space decidely narrower than the orbit; teeth relatively coarse, approaching those of *Bathygadus;* pyloric caeca 8; gular membrane black ..... *longifilis* (Western Atlantic).

6. GADOMUS DENTICULATUS, new species.

Bathygadus longifilis WEBER, Fische der *Siboga*-Expedition, 1913, p. 171.

Type-specimen.—Cat. No. 78207, U.S.N.M., 307 mm. long to end of regenerated pseudocaudal, 112 mm. long to anus, dredged by the *Albatross* off northern Mindanao, at a depth of 220 fathoms, at station 5505.

At each of the following stations a single paratype was dredged, with the exception of station 5198, where two were obtained:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.
			° *F.*
5123	East coast of Mindoro	108	.....
5198	Vicinity of western Bohol	220	53.9
5406	Vicinity of Leyte	298	.....
5410	Between Cebu and Leyte	385	.....
5445	East coast of Luzon	383	44.3
5505	Vicinity of northern Mindanao	220	.....
5587	Off east coast of British North Borneo	415	42.3
5589	....do	260	45.7
5624	Between Gillolo and Makyan Islands	288	.....

[1] Ventral 8-rayed in a small Hawaiian specimen perhaps distinct from *B. melanopterus,* having also a wider interorbital space, etc. (See Gilbert, Bull. U. S. Fish Comm., 1903 (1905), sec. 2, p. 659.)

The general outlines of the body and head agree closely with those of other species. The greatest depth of body is equal to the distance from the tip of the snout to the angle of the preopercle; the greatest width, over the pectoral bases, is contained 2.3 times in the head and about twice in the depth of the body.

The head is rather firmer and less cavernous than in such species as *G. multifilis*, *G. introniger*, and *G. longifilis;* the greatest width of the head is about equal to the length of the snout plus the eye. The orbit is nearly round; its length is contained 1.15 (to 1.05)[1] times in length of snout, 4.3 (to 4.2)[1] times in length of head. The interorbital is narrow and flat, with clearly concave sides; its least width is contained 1.7 (1.5 to 1.8)[1] times in the greatest orbital

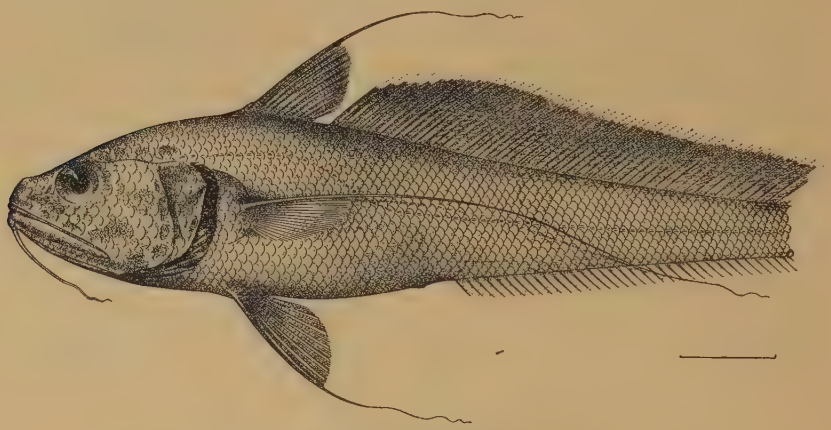

FIG. 3.—GADOMUS DENTICULATUS. TYPE.

length, and is about one-half as great as the length of the snout. The least width of the bony suborbital is about two-thirds that of the interorbital. The two limbs of the opercle do not end in spines; the lower margin of the interopercle is arched upward a little before its evenly rounded angle. The mouth, as in the other species, is large and moderately oblique; the upper jaw, the length of which is contained 1.85 (1.8 to 1.9)[1] times in the length of the head, extends but slightly beyond the vertical passing through the posterior margin of the orbit. The teeth are so excessively fine and crowded that they can not be individually distinguished by the unaided eye; they form an even surface on the two jaws, as also in *G. colletti*, the Japanese representative of *G. denticulatus*, and in *G. arcuatus*, an Atlantic species; the bands of teeth are strongly convex in cross section, the mandibular band being only one-third as wide as

[1] These measurements are of the three paratypes more than 100 mm. long to anus. Measurements of smaller specimens are given in the following table.

the premaxillary band, which is flattened and greatly expanded in width at the middle of the length of the maxillary; the greatest width of the band is contained 1.25 (to 1.65) times in the least width of the bony suborbital.

The length and strength of the barbel are too variable to serve as good specific characters, as can be understood by an examination of the tables of measurements following the descriptions of each species. Pseudobranchial filaments are developed, but are exposed only in our smallest specimens, having become covered in the large specimens by the fold of membrane which precedes the first gill-arch, and lines the deep pit opposite the upper angles of the arches. The gill-rakers are blunt at their tips, rather robust, smooth, rather widely spaced, and short, their length in the larger specimens being less than least width of the bony suborbital; they number 5+17 and 5+19, on the left and right sides, respectively, of the type, and vary from 4 to 5+19 to 21 in the nine paratypes counted. The branchial aperture curves forward to below the middle of the eye. A narrow slit is present behind the fourth gill-arch. Seven branchiostegals. As in our specimens of all four Philippine species of this genus, as well as in the specimen of *G. colletti* of Japan which we examined, the scapular foramen is in contact with the suture separating the hypercoracoid from the hypocoracoid.

The scales are thin, deciduous, and cycloid. When examined under the compound microscope, the numerous striae are seen to be finely denticulate; on the exposed portion of the scale the striae are arranged concentrically, but on the basal portion, which is the larger, they form an extremely irregular zigzag pattern, and are perpendicular (or nearly so) to the basal margin of the scale; these striae are connected by numerous cross ridges. Certain marks or narrow zones may be annular rings, as they bear a striking similarity to certain marks so interpreted in other marine fishes.[1] Several scales from the type specimen, 112 mm. long to anus, show three such rings; those from the paratype 111 mm. long, from *Albatross* station 5624, show two rings. A region of closely approximated circuli, occurring just outside the focus of the scale, suggests a similar area in salmonoid and other fishes, which in those forms is regarded as the winter zone of the first full year's growth. A similar area is more clearly marked off on the scales from *G. colletti* of Japan, and is also indicated on the scales of *G. longifilis* and the other species reported on in this paper. Those species inhabiting deeper water, however, do not show more than traces, if anything, of those marks which resemble annular rings. That fact is in harmony with the view that

[1] Such as *Cynoscion* (Taylor, Bull. U. S. Bur. Fish., No. 34, 1914 (Sept. 23, 1916), pp. 295–330; numerous figures).

these marks are seasonally made. If these zones are season indicators, then the type specimen was in its fourth or fifth year.

Eight series of scales separate the front of the second dorsal from the lateral line series in the type and in seven paratypes, but there are seven series in two paratypes. The scales on the mandible, in a single row anteriorly, become biserial posteriorly.

The lateral line below the anterior end of the second dorsal suddenly dips downward, as in other species, to its position below the middle of the tail.

The first dorsal spine is concealed; the second is three-fourths as long as the length to anus, but varies from a little less than two-thirds to 1.05 times that distance. The second pectoral ray is lengthened into a slender filament 1.4 times the length to anus (varying to slightly shorter than that distance in the paratypes). The outer ventral ray is always less than twice as long as the head and is always shorter than the length to anus, being 0.7 of that length in the type. The origin of the first dorsal is almost on a vertical with the insertions of the paired fins. The distance between the anus and the ventral is more than two-thirds the length of the head.

The pyloric caeca are short and numerous, 61, 69, and 75 in the three specimens counted.

Color, in alcohol, deep brown, lighter below and with silvery reflections on the lateral and ventral surfaces of the head and trunk; the branchiostegal membranes are dark brown, the gular membranes light; the lower lip is white. The walls of the buccal cavity are light near the mouth; the branchial cavity is lined with purplish black, with a wide whitish area along the opercular and branchiostegal margins. Parietal portions of peritoneum and the visceral portions over all the organs except the pyloric caeca, deep purplish black. Dorsal black, a little lighter on basal part of fin; anal light anteriorly, but shading into black posteriorly. Pectoral and ventral dark, with lighter filaments and a lighter area near their lower or inner basal portions. Other specimens are very much lighter in color; in these only the first dorsal is blackish, and it is lighter near its base, and dusky posteriorly; only those rays of the paired fins next to the filaments are dark; the dark portion of the branchial cavity is brown with lighter clouding, while the peritoneum shows much silvery through the dusky purplish color.

The distinguishing characters of this species are given in the key. It is probably most closely related to *G. colletti*, its Japanese representative, though allied with *G. magnifilis*, the next species to be described.

Table of measurements in hundredths of length to anus.

	G. colletti.			*G. denticulatus.*				
	Topotypes.			Type.	Paratypes.			
Albatross station	5062	5065	5067	5505	5624	5587	5505	5589
Total length in mm	302	[1] 190	68	[1] 307	[1] 306	[1] 277	[1] 230	[1] 214
Length to anus in mm	99.5	60	22.5	112	111	104	109	81.5
Length of head	56	60	61	53	54	55	56	54
Length of orbit	14.3	17	22	12.5	13.3	14	14.5	14.5
Width of interorbital	9	10.5	13	8	9	8.5	8	9
Width of suborbital	7	6	.....	5.5	5.3	6	5.3	6
Orbit to preopercle	25	26	.....	23	24	25	24	25
Length of snout	15	16	14	14	15.5	15	15.3	14
Length of upper jaw	29.6	32	37	28.5	29.5	30	29.5	30
Width of band of teeth in upper jaw	.....	3	.....	4.3	4.3	4	4.3	4
Length of barbel	47	56	57	33.5	35	51	32	44
Depth of body, about	45	48.5	.....	44	41	44	41	42
Width of body, about	26.5	27	.....	.....	26.5	29	.....	29
Anus to ventral	38	37	36	45	42.5	43	40	43
Ventral to end of pectoral girdle	.....	26	26	27	28.5	26.5	.....	27.5
Height of second dorsal spine	91	71	41	75	81	58	79.5	105
Height of third dorsal ray	31	36	.....	26	32	34	31.5	36.5
Length of base of first dorsal	18	19	20	18	18.6	18	19	17
Length of first pectoral ray	10	11	.....	6.5	8.5	12.3	10	14
Length of second pectoral ray	100	84	43	141	131	105.5	111+	134
Length of third pectoral ray	33	36	.....	28	34	33.5	33	41.5
Length of outer ventral ray	41	55	72	70	57	52	81	.....
Length of second ventral ray	31.6	36	33	29.5	30.5	33	32.5	Short.
Length of gill-rakers	5.5	8	.....	4	4	5.3	5	6
Scales above lateral line	9	9	.....	8	8	8	8	8
Soft rays, first dorsal	10	10	10	10	11	11	10	10
Ventral rays (both sides)	8	8	8	8	8	8	8	8
Pectoral rays (left side)	20	18	.....	18	19	19	18	19
Outer gill-rakers:[2]								
Left side	5+22	6+21	.....	5+17	×+19	5+19	.....	4+19
Right side	.....	5+20	.....	5+19	5+19	4+20	6+20	5+20

	G. denticulatus.				
	Paratypes.				
Albatross station	5589	5410	5198	5445	5198
Total length in mm	[3] 263	[4] 226	[4] 203	[4] 183	[4] 197
Length to anus in mm	95	78	66	71	66
Length of head	55	57	57	59	55
Length of orbit	14	14	16	16.5	15
Width of interorbital	9.3	9.2	9.5	9.3	9
Width of suborbital	6	5.5	6	6	5.5
Orbit to preopercle	24	24	25	25.5	24
Length of snout	14	15	16	15	14
Length of upper jaw	30	31.5	32	32	31
Width of band of teeth in upper jaw	4	4	3.8	4	3.8
Length of barbel	40	50	53	56	52
Depth of body, about	46	41	47	45	43
Width of body, about	27	23	28	.....	.....
Anus to ventral	47	39	38	41	47
Ventral to end of pectoral girdle	28.5	.....	27.5	27	.....
Height of second dorsal spine	90	84	87	.....	102
Height of third dorsal ray	.....	30	.....	.....	.....
Length of base of first dorsal	18.5	17	17	17	17
Length of first pectoral ray	10	13	12	11	13
Length of second pectoral ray	134	139	139	93	140
Length of third pectoral ray	46	29	32	36	31
Length of outer ventral ray	65	74	83	51	86
Length of second ventral ray	35	33	33	32.5	34
Length of gill-rakers	5	7	7.5	6.5	8
Scales above lateral line	8	7	7	8	8
Soft rays, first dorsal	11	10	10	10	10
Ventral rays (both sides)	8	8	8	8	8
Pectoral rays (left side)	18	18	19	22	18
Outer gill-rakers:[5]					
Left side	4+20	5+21	5+21	5+21	5+20
Right side	4+21	5+21	5+21	5+21	5+20

[1] To end of large or small pseudocaudal.
[2] Including anterior rudiments.
[3] A female with mature eggs; pseudocaudal moderate.
[4] A pseudocaudal developed.
[5] Including anterior rudimentary gill-rakers.

Only two specimens were not measured, owing to their poor state of preservation. They are about 52 and 76 mm. long, respectively, to the anus, and agree with the other specimens in the diagnostic characters.

(*denticulatus*, in reference to the fine teeth.)

7. GADOMUS MAGNIFILIS, new species.

Type-specimen.—Cat. No. 78208, U.S.N.M.; 337 mm. long to the end of a very small pseudocaudal, 103 mm. long to the anus; dredged at *Albatross* station 5515, off northern Mindanao, in "about 700" fathoms, near the type locality of *G. denticulatus*, but in deeper water.

Two smaller paratypes were also obtained:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.
			°*F.*
5201	Sogod Bay, southern Leyte Island	554	52.8
5423	Near Cagayan Island, Jolo Sea	508	49.8

The form of the body is similar to that of related species; the greatest depth is equal to the greatest length of the head to the preopercular margin; the greatest width across the pectoral bases is about half the depth, and is contained 2.35 times in the head. The head is somewhat more cavernous and angular in outline than in *G. denticulatus*, as correlated with its living at greater depths; the outline of the snout at the tip of the premaxillary forms little more than a right angle. The width of the head is almost equal to the length of the snout plus that of the orbit. The orbit, as deep as long, is contained 4.65 (4.4)[1] times in the length of the head, 1.3 (1.2)[1] times in the length of the snout. Least width of interorbital, 1.37 (1.5)[1] in orbit. The least width of the bony suborbital region is nearly two-thirds that of the interorbital. The maxillary reaches a little beyond the vertical from the posterior orbital margin; length of the upper jaw, 1.8 in head. The teeth, though minute, are of sufficient size and spacing to be readily distinguished from one another by the unaided eye. The bands of teeth in the jaws are rather narrow, and are somewhat rounded in cross-section; the premaxillary band is widened posteriorly, but lacks the flat process, extending inward, which is found in *G. denticulatus;* the greatest width of the premaxillary band is contained only 2.0 (to 2.4)[1] times in the least bony suborbital width. The teeth in the bands are aligned in lengthwise series. The barbel is long and slender, being over half as long as the head in the type-specimen; but its length may be expected to

[1] In the paratype from station 5201 (70 mm. long to anus).

vary widely, as it does in the related species. The pseudobranchiae are covered by membrane in the three specimens at hand. The rather widely spaced gill-rakers are smooth on their inner edge, and are bluntly tipped; they are about half as long as the orbit. Gill-rakers 5+23 and 5+24 in the type, 5+22 and 5+21 in the larger paratype. The branchial aperture extends forward to below the front of the pupil; a slit is present behind the last gill; seven branchiostegals. In the paratype examined the scapular foramen is in contact with both the hypercoracoid and the hypocoracoid.

The scales closely resemble those of *G. denticulatus* in their finer structure, but differ remarkably in one point: the marks which were considered as possible season-indicators are much less pronounced, and consist chiefly of a sudden bending of the striae along a line

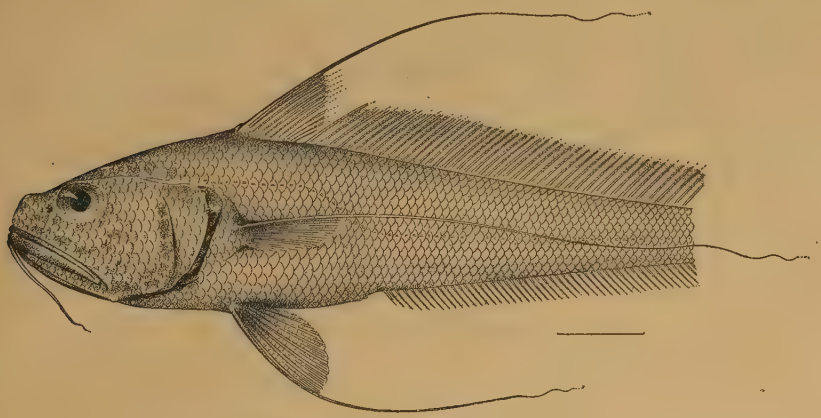

FIG. 4.—GADOMUS MAGNIFILIS. TYPE.

parallel with the margin of the scale (as seen on a scale from the type, 103 mm. long to the anus, and also in one from the paratype, 70 mm. long to anus.) In each of these a slight suggestion of a "check" occurs outside of the better defined one. A light streak was observed beneath this line in the substance of the scale. A marked approximation of the rings a short distance out from the center gives much the appearance of the first winter check in the salmon scale. The less pronounced marks on the scales of this species lends some support to the assumption that they are season marks, as the seasons would be expected to leave a lesser trace on a fish inhabiting greater depths.

Seven scales were counted, in each of the three specimens, in a series between the origin of the second dorsal and the lateral line, not including the lateral line scale. The mandibular scales are in a single series, with a few lateral scales posteriorly. The lateral line is elevated on the trunk.

The first dorsal spine is concealed; the second spine is produced into a long filament, and is about 1.2 times as long as the distance between the tip of snout and anus in the type (more than 1.4 times that distance in a paratype). The second pectoral ray is similarly elongate, varying from one and three-fourths to almost two times the length to anus. The outer ventral ray, likewise produced, is 1.1 times the length to anus in the type and one paratype, and but little shorter than the length of anus in the other paratype. The first dorsal and the paired fins all originate on about the same vertical. The distance from the anus to the ventral base is a little more than half the length of the head.

Pyloric caeca in two specimens, 24 and 29.

The color of the preserved specimens, from which nearly all of the scales have been lost, is light brown, with silvery reflections on the abdomen and the sides of the head. The exposed portion of the mandible is dusky. The branchiostegal membranes are brownish black, the gular membranes light. The buccal, branchial, and abdominal cavities are lined with brownish black membranes; the branchial cavity has a light margin on its outer wall, along the edge of the opercle and branchiostegal membranes; the walls of the buccal cavity are not light near the gape. The dorsal fins, including the produced spine, are blackish, except on a narrow lighter basal streak; the anal fin is light anteriorly, becoming wholly dark, like the dorsal, posteriorly. The basal region of the paired fins is dark.

Summary of the differences between Gadomus magnifilis and G. denticulatus.

	G. magnifilis.	*G. denticulatus.*
Length of head[1]	[2] 0.61	[2] 0.53 to 0.56
Length of orbit in head	[2] 4.65	[2] 4.2 to 4.3
Length of orbit in snout	[2] 1.3	[2] 1.05 to 1.15
Width of interorbital in orbit	[2] 1.37	[2] 1.5 to 1.8
Length of upper jaw[1]	[2] 0.335	[2] 0.285 to 0.30
Teeth[3]	[4]	[5]
Width of premaxillary band in suborbital	2.0 to 2.4	[3] 1.25 to 1.65
Distance from anus to base of ventral[1]	0.38 to 0.47	[3] 0.33 to 0.36
Gill-rakers on lower limb of first arch	[3] 21 to 24	[3] 17 to 21
Height of second dorsal spine[1]	[3] 1.185 to 1.40	[3] 0.58 to 1.05
Length of second pectoral ray[1]	[3] 1.70+ to 1.95	[3] 0.93 to 1.41
Length of outer ventral ray[1]	[3] .97 to 1.11	[3] .51 to .86
Buccal cavity color[3]	[6]	[7]
Number of pyloric caeca	[3] 24 to 29	[3] 61 to 75

[1] Expressed in hundredths of length from tip of snout to anus.
[2] In specimens over 100 mm. long to anus.
[3] Including smaller specimens.
[4] Distinguishable to unaided eye.
[5] Not distinguishable to unaided eye.
[6] Wholly dark.
[7] Lighter anteriorly.

Although the preceding table indicates the marked differences between *G. magnifilis* and its nearest relative, *G. denticulatus*, it is quite probable that it has been derived from that form. The three stations at which this species were dredged are all in the Jolo (Sulu)

Sea, and it is not improbable that it is confined to the peculiarly warm depths of that body of water.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.	
Albatross station	5515	5201	5423
Total length in mm	[1] 337	[1] 235	[2] 220
Length to anus in mm	103	70	63
Length of head	61	61.5	.....
Length of orbit	13	15	[2] 17
Width of interorbital	9.5	10	[2] 10.5
Width of suborbital	6	6	.....
Orbit to preopercle	27	27	[2] 28
Length of snout	16	17	.....
Length of upper jaw	33.5	34	[2] 36
Width of band of teeth in upper jaw	2.9	2.5	[2] 3.0
Length of barbel	37	44	[2] 42
Depth of body, about	48	49	.....
Width of body, about	27	28	.....
Anus to ventral	36.5	33	[2] 36
Ventral to end of pectoral girdle	30.5	28.5	.....
Height of second dorsal spine	118.5	.....	[2] 140+
Height of third dorsal ray	25	.....	[2] 25
Length of base of first dorsal	17.5	18	.....
Length of first pectoral ray	9	10	.....
Length of second pectoral ray	177	170+	[2] 195
Length of third pectoral ray	33	31.5	.....
Length of outer ventral ray	110	97	111
Length of second ventral ray	33.5	36	.....
Length of gill-rakers	7	9	9
Scales above lateral line	7	7	7
Soft rays, first dorsal	10	9	10
Ventral rays (both sides)	8	8	8
Pectoral rays (left side)	18	17	17
Outer gill-rakers:			
Left side	5+24	5+22	.....
Right side	5+23	5+21	.....

[1] A small pseudocaudal developed.
[2] The measurements on this specimen are to be regarded as approximate only, owing to its very poor condition.

(*magnifilis*, in reference to the large fin-filaments.)

8. GADOMUS INTRONIGER, new species.

Gadomus multifilis, RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 106, text fig. 1 (in part).

Type-specimen.—Cat. No. 78209, U.S.N.M., 329 mm. long to the end of a large regenerated pseudocaudal, 119 mm. long to anus. Collected by the steamer *Albatross* at station 5648, at which six paratypes also were obtained. Locality, Buton Strait, near Celebes; depth, 559 fathoms; bottom temperature, 39.2° F.

A single paratype is in the collection from each of the following stations:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.
			° F.
5274	China Sea, off southern Luzon	525	41.5
5460	Lagonoy Gulf, eastern Luzon	300	.....
5585	East Coast, British North Borneo	476	41.1
5586	.....do	347	44.0
5647	Buton Strait, near Celebes	519	.....
5651	Gulf of Boni	700	38.7
5656	.....do	484	41.2

The body contours are less strongly curved than in the two preceding species, *G. denticulatus* and *G. magnifilis;* the greatest depth, below the origin of the first dorsal, does not equal the length of the head to the margin of the preopercle at its angle as it does in those species, but is about equal to the distance from the tip of the snout to the preopercular ridge at its angle. The greatest width of the body across the bases of the pectoral fins is contained 2.35 times in the length of the head, and is more than half the greatest depth; the greatest width of the head is a little less than the length of the snout plus that of the orbit. The head is about as cavernous as in *G. magnifilis;* not so firm as in *G. colletti* or *G. denticulatus*, but firmer than in *G. multifilis*. The angle of the snout at the tip of

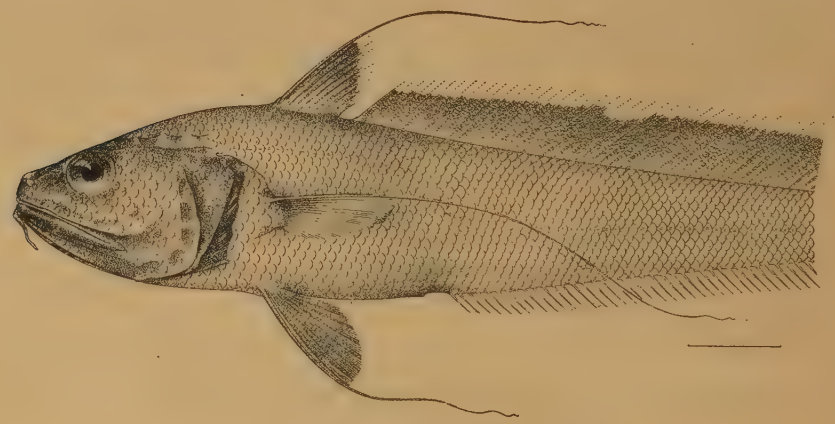

FIG. 5.—GADOMUS INTRONIGER. TYPE.

the premaxillary spines is quite obtuse. The horizontal length of the orbit, greater than the vertical, is contained 4.7 (to 4.5)[1] times in the length of the head, and 1.25 (to 1.15)[1] times in the length of the snout. The interorbital is almost as wide as the orbit, and about twice as wide as the suborbital. The upper jaw, which is contained 1.8 (to 1.7)[1] times in the head, extends well beyond the eye. The teeth, like those of *G. multifilis*, as distinguished from those of *G. denticulatus*, though minute, are of sufficient size to be readily differentiated from one another without a lens. The bands of teeth, occurring on the jaws only, are rather narrow and are not strongly convex in cross section. The teeth forming the bands are aligned in a single series separated by narrow toothless streaks. The greatest width of the premaxillary band is contained 2.4 (2.2 to 3.0) times in the least width of the suborbital. The mental barbel is long and slender, but of extreme variability, its length ranging from

[1] In paratypes more than 100 mm. long to anus.

half that of the eye to two-thirds that of the head (1.25 in eye in type); it is probably a healed stub when extremely short. The pseudobranchial filaments are covered by a membrane, which is ruptured in the type-specimen.

The gill-rakers are slightly roughened on their inner edge; are bluntly tipped, rather widely spaced, and are short, being about as long as the least suborbital width in the adults, but relatively a little longer in the young. Number of gill-rakers 6+23 and 6+24 on the two sides of the type, varying from 5+20 to 6+24 in the paratypes; other gill-structures as in related species. The scapular foramen is in contact with both the hypercoracoid and the hypocoracoid.

The scales in their finer structure are very similar to those of the other species. Toward the margin of the scale in the type-specimen there appears a break in the rings like the breaks which appeared more strongly in *G. denticulatus*. There is also that approximation of striae which, occurring near the center of the scale, may represent a check in the first year's growth. This approximation of the rings occurs in all of the species examined.

There are constantly seven scales in a series between the origin of the second dorsal fin and the lateral line scales. The scales on the mandible are in two series except at the anterior end of the rami. The lateral line, high on the trunk, runs below the middle of the tail.

The first spine of the dorsal fin is concealed; the second is greatly produced, but less so than in *G. multifilis*, *G. longifilis*, or *G. magnifilis;* its length is a half greater than that of the head, or 0.85 of the length to the anus in the type, varying in the paratypes from shorter than the head to considerably less than twice the head, and varies from half the length to anus to a little more than that length. The length of the second pectoral ray varies greatly, from less than three-fourths to one and a half times the length to anus. The length of the outer ventral ray never approaches twice that of the head, but is always longer than the head; it is four-fifths (0.65 to 0.93) as great as the length to anus. The first dorsal, pectoral and ventral fins begin on about the same vertical. The distance between the anus and the base of the outer ventral ray is contained about 1.5 times in the head.

Pyloric caeca (in several specimens), 35 to 52.

The color was apparently dark brown, a little darker on the belly, and blackish on the snout, mandible, and sides of the head. The silvery reflections on the abdominal region and on the sides of the head are probably less marked than in the preceding species. The buccal, branchial, and peritoneal cavities are wholly lined with black, being

without light margins. The first dorsal fin is light throughout; the second dorsal has a narrow light streak near its base, but the main part of the fin is dusky, shading into black anteriorly; the anal is dusky throughout. The dusky pectoral fin becomes lighter toward the tip of the filamentous ray and blackish near the base of the fin. The blackish ventral fin becomes lighter toward the inner margin of its base.

This species, together with *G. multifilis*, is readily distinguishable from *denticulatus*, *colletti*, and *magnifilis*, differing from all in the wider interorbital space and the wholly dark branchial cavity, from *denticulatus* and *colletti* also in the coarser dentition, and from *magnifilis* also in the shorter fin filaments. The number of pyloric caeca seems also to be characteristic of the species; there are 24 to 29 in *magnifilis*, 35 to 52 in *intronigер*, 61 to 75 in *denticulatus*, and 95 in *colletti*.

From *G. multifilis*, *G. intronigер* differs in a number of diagnostic characters: the gill-rakers are shorter, more widely spaced and bluntly, instead of sharply, tipped, and they are fewer in number, there being 20 to 24 instead of 26 below the angle of the outer arch; the head is much firmer, the sensory channels being less developed; the teeth are considerably finer, and in wider bands, the premaxillary band being contained 2.2 to 3.0 in the suborbital width, rather than 3.3 to 3.8 times; the body is a little more robust, the depth in *G. multifilis* not equaling the length of the head to the angle of the preopercular ridge; the distance between the anus and the base of the ventral is decidedly longer, being two-thirds instead of half as long as the head; there are 7 instead of 6 scales above the lateral line; the fin filaments are shorter, the dorsal spine and the outer ventral ray being shorter, instead of longer, than twice the length of the head. *G. intronigер* differs in similar details from *G. melanopterus* of Hawaii, and from *G. longifilis* in the wider interorbital, wider bands of teeth, and especially in the fewer gill-rakers (see measurements and counts of *G. longifilis* in the table of measurements and counts of the next species, *G. multifilis*). The number of pyloric caeca proves valuable in distinguishing these species also; 35 to 52 were counted in *G. intronigер*, 12 to 16 in *G. multifilis*, 15 in *G. melanopterus*, and but 8 in *G. longifilis*.

This species lives in water probably deeper, on the average, than that inhabited by *G. denticulatus*. Its general appearance and structure is in harmony with such a difference in distribution. *G. intronigер* inhabits depths as great as those from which *G. magnifilis* was dredged, but in much colder water.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.					
Albatross station	5648	5648	5648	5648	5585	5648	5648
Total length in mm	[1] 329	375	[1] 296	[1] 334	323	[1] 301	[1] 310
Length to anus in mm	119	118	111	110	100	97.5	95
Length of head	57	57	57	57	56	57	56
Length of orbit	13	13	13	13	13	12.5	13
Width of interorbital	12.5	11.5	11.5	13	12	11.3	12.3
Width of suborbital	6	6	6	6	6	7	5.5
Orbit to preopercle	26	27	26	27	27	27	26.5
Length of snout	16	15	16	16	15.5	15	16
Length of upper jaw	31	32.5	32	33	32	33	32
Width of band of teeth in upper jaw	2.5	2.4	2.3	2.4	2.7	2.3	2.2
Length of barbel	10.5	6.5	34.5	33	15.5	16	33
Depth of body, about	41	.....	42	42	38	39	43
Width of body, about	.....	.....	.....	.....	24	24	.....
Anus to ventral	40	39	.....	45	45	40	40
Ventral to end of pectoral girdle	28	.....	.....	.....	27	30	29
Height of second dorsal spine	85	84	95	98	92+	84	100.5
Height of third dorsal ray	.....	.....	.....	.....	25	24	26
Length of base of first dorsal	16	16.5	17	16.5	15	17	18.5
Length of first pectoral ray	11	6.5	10.5	6	7.5	8	.....
Length of second pectoral ray	128+	129+	113	128	152	133+	.....
Length of third pectoral ray	30	28	28.5	30	28	29	.....
Length of outer ventral ray	79.5	67	68	68	91	86	65
Length of inner ventral ray	32	.....	.....	.....	31	31	29
Length of gill-rakers	5.5	6	6	5	6.5	7	5.5
Scales above lateral line	7	7	7	7	7	7	.....
Soft rays, first dorsal	10	10	10	10	9	10	10
Ventral rays (both sides)	8	8	8	8	8	8	8
Pectoral rays (left side)	18	19	17	20	18	17	.....
Outer gill-rakers: [2]							
Left side	6+23	.....	.....	6+24	.....	.....	4+23
Right side	6+24	6+22	.....	6+24	5+23	.....	4+23

Albatross station	5274	5463	5586	5651	5648	5647
Total length in mm	[1] 236	[1] 216	240	[1] 213	[1] 205	163+
Length to anus in mm	78	75	75	64	62	51
Length of head	59	57	58	59	59	62
Length of orbit	14	14	14	14.5	15	16
Width of interorbital	12	12.5	12	12.5	13	13
Width of suborbital	6	6	6	6.5	6	7
Orbit to preopercle	27	28	26	28	27	27
Length of snout	16	16	16	16	16.5	17
Length of upper jaw	34	33	33	33.5	35	36
Width of band of teeth in upper jaw	2.4	2.2	2.5	2.6	2.3	2.5
Length of barbel	32	39	39	22	24	31
Depth of body, about	45	45	43	41	39	41
Width of body, about	.....	24	24	21	23	20
Anus to ventral	39	43	41	39	38	39
Ventral to end of pectoral girdle	26	28	30	30	27	31
Height of second dorsal spine	.....	.....	103	96	.....	51
Height of third dorsal ray	.....	.....	27	.....	.....	27
Height of base of first dorsal	16	16.5	16	15	15	16.5
Length of first pectoral ray	8	6	9	9	7	8
Length of second pectoral ray	72	.....	122	134	.....	121
Length of third pectoral ray	.....	.....	31	.....	.....	27
Length of outer ventral ray	.....	.....	77	74	82+	93
Length of inner ventral ray	.....	31	33	.....	31	32
Length of gill-rakers	7	7	7	7	8	9
Scales above lateral line	7	.....	7	7	7	7
Soft rays, first dorsal	10	9	9	9	10	9
Ventral rays (both sides)	8	8	8	8	8	8
Pectoral rays (left side)	19	19	18	17	19	20
Outer gill-rakers: [2]						
Left side	6+25	5+22	5+20	5+24	5+22	6+22
Right side	6+23	4+24	5+20	.....	.....	.....

[1] To end of small or large pseudocaudal.

[2] Including anterior rudiments.

(*introniger*, in reference to the wholly dark buccal and branchial cavities.)

9. GADOMUS MULTIFILIS (Günther).

Bathygadus multifilis GÜNTHER, Report on the Deep-Sea Fishes, *Challenger* Expedition, 1887, p. 155, pl. 42, fig. B (near Philippine Islands).

Gadomus species GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 153 (Japan).

?*Bathygadus longifilis* ALCOCK, Ann. Mag. Nat. Hist., ser. 6, vol. 6, 1890, p. 302, and ser. 6, vol. 8, 1891, p. 123; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 120 (Arabian Sea and Bay of Bengal).—CHUN, Aus den Tiefen des Weltmeeres, 1900, p. 504, fig. East Coast of Africa).—BRAUER, Die Tiefsee-Fische, 1906, p. 270, pl. 12, fig. 7.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.
			° *F.*
5467	Lagonoy Gulf, east coast of Luzon	480	.....
5582	Vicinity of Darvel Bay, Borneo	890	38.3
5607	Gulf of Tomini, Celebes	671	.....

We refer with some doubt the three specimens with the above data to Günther's species. The only character given in his original description accurately serving to distinguish between the species at hand and *G. introniger* is the distance between the anus and the base of the ventral. Our three specimens agree with Günther's description in that character, the distance being half as long as the head, while it is two-thirds as long as the head in *G. introniger*. One difficulty is that Günther's figure does not agree with his description in this regard. Assuming, then, that this species is *G. multifilis*, we find that Alcock, Brauer, and other European naturalists err in identifying it with *G. longifilis*—a species differing in the more numerous gill-rakers (30 to 35 instead of 26 on lower limb of outer arch); in the narrow band of premaxillary teeth, which is contained 4.8 instead of 3.0 to 3.8 times in the least bony suborbital width; in the much narrower interorbital; and in certain details brought out in the following table of measurements, which includes one of the types of the Atlantic species. *G. longifilis* should no longer be confused with distinct species inhabiting distant seas.

From the Hawaiian species (*G. melanopterus*), *G. multifilis* is less readily distinguished, and it is possible that the two species are identical. There are nine ventral rays in the type of *G. melanopterus* and but eight in *G. multifilis*. The scapular foramen in *G. melanopterus* was described as being "wholly within the hypercoracoid," while in *G. multifilis* it is on the suture between the hypercoracoid and the hypocoracoid.

A brief description of our three specimens (61 to 72 mm. long to anus) is appended:

The head is soft and spongy, due to the spaciousness of the sensory canals, which appear to be more highly developed than in any other

species of the genus, thus rendering the appearance of the fish most similar to that typical of *Bathygadus*, in which genus these canals are usually enlarged. The outlines of the body are less curved than in *G. colletti*, *denticulatus*, or *magnifilis*, and the depth is less, not being equal to the length of the head to the angle of the preopercular ridge. Length of orbit, 1.2 in snout, 4.2 or 4.3 in head. The interorbital is almost as wide as the eye, and is over twice the least width of the bony suborbital; length of upper jaw, 1.6 to 1.7 in head, extending well beyond orbit; the teeth are coarser than in the other Philippine species and are confined to very narrow bands, the greatest width of the premaxillary series being contained from 3.3 to 3.8 times in the least suborbital width. Gill-rakers long, sharp, crowded, strongly compressed, and rough on their inner edge, 6+26 on the outer arch. The scapular foramen lies in the suture between the hypercoracoid and the hypocoracoid. Small pseudobranchiae are developed.

Six scales, exclusive of the lateral line scale, in a series between lateral line and origin of second dorsal. In their finer structure the scales seem to offer good specific characters. In *G. colletti*, *G. denticulatus*, and *G. magnifilis* the rings from the first, second, or third, extend forward on the scale to meet their fellow at an acute angle. The "circuli" thus soon become perpendicular to the basal margin of the scale. In *G. intropiger* and in *G. multifilis* the first four rings are subcircular, and even after these, the "circuli" do not run so far from the circular course as do those of the other three species. In all of these five species the circuli are first well spaced, but soon become more closely approximated, the number of striae out to the end of this crowded area being 6 to 10. In the true *G. longifilis* this area of approximated circuli, very decidedly shown, occurs at the very center of the scale, and includes the first five circuli (determined in one of the type-lot). In *longifilis* the "circuli," even more than in *G. multifilis*, retain their circular character. However, the general character of the scales is the same in all the species. The "circuli" posteriorly are nearly concentric, while anteriorly they are more or less nearly perpendicular to the scale margin. They are finely denticulate, and are connected by numerous cross ridges.

On the trunk the lateral line runs above the middle of the sides, but descends on the tail to a position below the middle of the depth.

The fin filaments are very long, the second dorsal spine and the outer ventral ray being each twice as long as the head.

Pyloric caeca in a Philippine specimen, 12; in the Japanese specimen referred to *G. multifilis*, 16. Brauer counted 15 and 22 in two specimens, Alcock counted 20 in one of the Indian specimens. Whether Brauer's and Alcock's specimens are referable to *G. multi-*

filis is open to doubt, owing to their failure to describe in detail those characters which we find of highest value in the discrimination of the species.

The color is dark brown, becoming blackish on the belly and about the nostrils; the jaws, the branchiostegal and gular membranes, as well as the entire linings of the buccal, branchial, and peritoneal cavities, are black. The fins are mostly blackish, but the second dorsal is lighter anteriorly, especially near its base; the anal is dusky.

Table of measurements in hundredths of length to anus.

	Philippine Islands.			Japan.	(1)
Albatross station	5582	5607	5467	4973	2385
Total length in mm	172+	224+	252+	106+	250
Length to anus in mm	61	61	72	35	68
Length of head	61	63	62	62	61
Length of orbit	16	15.5	14	16	17
Width of interorbital	15	14.5	14	14	12.5
Width of suborbital	6	6.5	6.5	8	6
Orbit to preopercle	28	29	29	28	27
Length of snout	17	18	16.5	19	17
Length of upper jaw	38	37	38	.....	37
Width of band of teeth in upper jaw	1.8	1.7	1.8	.....	1.3
Length of barbel	36	40.5	36	.....	24
Depth of body, about	44	47	47	.....	44
Width of body, about	26	26	.....	.....	22.5
Anus to ventral	32	32	32	38	35
Ventral to end of pectoral girdle	28	.....	.....	27	31
Height of second dorsal spine	128	120+	127	.....	130
Height of third dorsal ray	.....	.....	24	.....	27
Length of base of first dorsal	16	20	19	19	19
Length of first pectoral ray	5.5	10	9	.....	9
Length of second pectoral ray	150	.....	.....	107	124
Length of third pectoral ray	.....	.....	27	.....	28
Length of outer ventral ray	122+	.....	130+	.....	139+
Length of inner ventral ray	31	.....	.....	.....	37
Length of gill-rakers	9	10.5	9.5	13	9
Scales above lateral line	6	6	6	.....	5
Soft rays, first dorsal	8	9	9	9	9
Ventral rays (both sides)	8	8	8	8	8
Pectoral rays (left side)	17	18	19	17	15–15
Outer gill-rakers [2] (left side)	6+26	6+26	.....	6+27	7+30

[1] One of the types of *Bathygadus longifilis*. [2] Including anterior rudiments.

(*multifilis*, in reference to the numerous fin filaments.)

Subfamily MACROURIDINAE.

Genus MACROURIDES Smith and Radcliffe.

10. MACROURIDES INFLATICEPS Smith and Radcliffe.

Macrouroides inflaticeps RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 139, pl. 31, fig. 2.

Type-specimen collected in 408 fathoms at *Albatross* station 5450, in Lagonoy Gulf, eastern Luzon; bottom temperature 42.3° F.

The relationships of this remarkably aberrant fish are discussed[1] in our paper on Japanese Macrouroids, in connection with the description of the related *Squalogadus modificatus*.

(*inflaticeps*, in reference to the immense head.)

[1] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 138, 140, 156.

Subfamily CORYPHAENOIDINAE.

Genus CORYPHAENOIDES Gunner.

11. CORYPHAENOIDES PARADOXUS (Smith and Radcliffe).

Macrourus paradoxus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 115, pl. 25, fig. 1.

This very distinct species was dredged by the *Albatross* at a depth of 1,105 fathoms, at station 5428 off eastern Palawan, at a bottom temperature of 49.7° F. It is known from the type-specimen only.

(*paradoxus*, in allusion to its supposed doubtful position, in reference to the group "*Chalinura*").

12. CORYPHAENOIDES DUBIUS (Smith and Radcliffe).

Macrourus dubius SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 117, pl. 25, fig. 3.

This species is apparently closely related only to *C. wood-masoni* (Alcock),[1] an Indian species. The interdorsal space and the outer ventral ray do not differ in length in the type of *C. dubius* and in Brauer's[2] specimens of *C. wood-masoni*.

According to the system of measurements outlined previously by us,[3] the orbit in the type and only known specimen is contained 1.4 times in the snout; 1.05 in interorbital width, 5 in head; the least interorbital width is contained 3 times in the head. The maxillary extends beyond the vertical from middle of eye. The basal fourth of the second dorsal spine is smooth. The angle of the preopercular ridge is bluntly pointed. There are six branchiostegal rays.

Measurements in hundredths of length to anus (150 mm.; total length to end of pseudocaudal, 425 mm.); length of head, 64; length of orbit, 13; least interorbital width, 13.5; least suborbital width, 9; distance between orbit and preopercular margin, 31.5; length of snout, 18; length of upper jaw, 21.5; depth of body, 45; width of body over pectoral bases, 30; distance between the center of anus and the base of outer ventral ray, 29; distance from base of outer ventral ray to isthmus, 29; height of second dorsal spine, 41; length of pectoral fin from base of second ray, 34; length of first pectoral ray, 4; length of second pectoral ray, 27.5; length of outer ventral ray, 44; length of second ventral ray, 23.

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[1] *Macrurus wood-masoni* Alcock, Ann. Mag. Nat. Hist., Oct. 1890, p. 301; Nov. 1892, p. 353; Jour. Asiatic Soc. Bengal, vol. 43, pt. 2, 1894, p. 126; Illustrations of the Zoology of the *Investigator*, Fishes, pl. 13, fig. 1, 1894; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 114.

[2] Brauer, Die Tiefsee-Fische, p. 267.

[3] Proc. U. S. Nat. Mus., vol. 51, 1916, p. 147.

Known only from the type taken at *Albatross* station 5511, in Iligan Bay, Mindanao, at a depth of 410 fathoms, where the bottom temperature was recorded at 53° F.

(*dubius*, apparently in reference to its supposed doubtful status or relationships.)

13. CORYPHAENOIDES ASPRELLUS (Smith and Radcliffe).

Macrourus asprellus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 118, pl. 26, fig. 1.

C. asprellus is related to *C. nasutus*,[1] a common Japanese species, but differs chiefly in the number and character of the scales. There are 5 or 6 instead of 6 or 7 between the origin of the second dorsal and the lateral line, excluding the lateral line scale. The spinules on the scales are coarser and longer; the rostral tubercles are much weaker and smaller, the terminal one bearing only six radiating spinous carinae; the scales on the preopercle have strongly divergent spinous carinae, while those of the same region in *C. nasutus* bear spinules in quincunx order as elsewhere on the body. Several additional differences are apparent: the dentition is stronger; the suborbital ridge is less pronounced; and the color is much darker. Certain proportions of the head differ: the snout is larger and its preoral projection greater; the interorbital is much wider; the maxillaries are much longer (3.1 in head).

It is perhaps more closely related to *C. hoskynii*,[2] from the Bay of Bengal (1,310 fathoms), differing chiefly from Alcock's description in not having "the last spinelet of the middle series greatly enlarged above the others."

The spinules of the scales are in quincunx order, and not in rows as originally described.

Known only from the type, collected at *Albatross* station 5632, southeast of Bachian Island, Dutch East Indies, at a depth of 845 fathoms.

(*asprellus*, diminutive of *asper*, a Japanese species.)

14. CORYPHAENOIDES SEMISCABER, new species.

Type-specimen.—Cat. No. 83625, U.S.N.M.; 251 mm. in total length, 74 mm. to anus; from *Albatross* station 5215, in 604 fathoms, east of Masbate Island, Philippine Islands; bottom temperature, 50.5° F.

Three smaller paratypes were also obtained: one at station 5124, in 218 fathoms, off the east coast of Mindoro; another at station

[1] For description and references see Gilbert and Hubbs, Proc. U. S. Nat Mus., vol. 51, 1916, p. 168.

[2] *Macrurus hoskynii* Alcock, Ann. Mag. Nat. Hist., Sept., 1890, p. 214; Jour. Asiatic Soc. Bengal, vol. 43, pt. 2, 1894, p. 126. Illustrations of the Zoology of the *Investigator*, Fishes, pl. 9, fig. 4, 1894; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 116.

5215, at which the type was also dredged; the third at station 5534, between Cebu and Siquijor, in 333 fathoms, and at a bottom temperature of 53.3° F.

Fin-rays—first dorsal, II, 10 (or 9); pectoral, 22 (20 or 21); ventrals, 8.

The body is deep and strongly compressed, the width over the pectoral bases being somewhat less than half the greatest depth (two-fifths depth in a paratype); greatest depth, 1.3 (to 1.15) in head; depth over anus, 1.5 (to 1.3) in head; depth, at a distance behind the head equal to twice its length, 1.7 (to 1.3) in head; at that point the width of the body is contained 4.8 (to 4.3) times in its depth. The dorsal edge of the tail is rounded, but the ventral

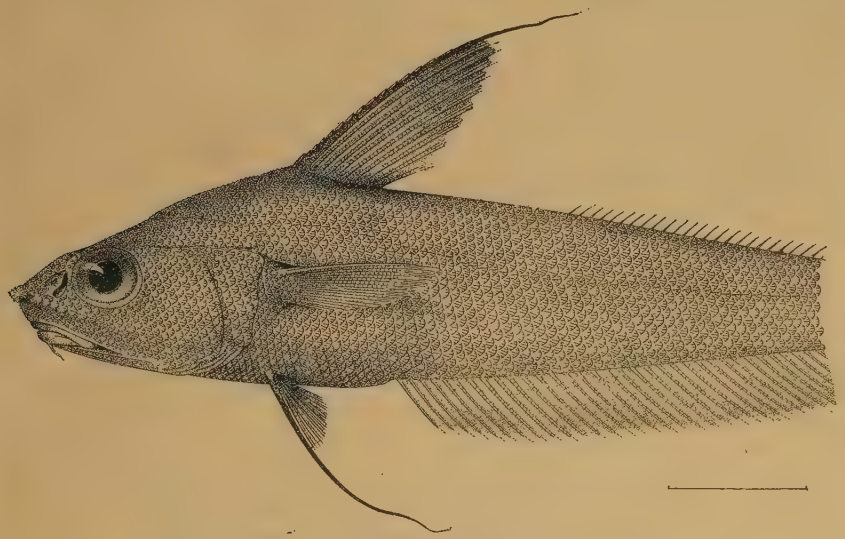

FIG. 6.—CORYPHAENOIDES SEMISCABER. TYPE.

edge is sharp. The dorsal contour is a little concave above the eyes, but slightly convex behind the occiput, oblique along the first dorsal base, and thence horizontal along the anterior half of the second dorsal. The ventral contour is a gentle curve from the mouth to the end of the second third of the total length, behind which the two contours converge to the end of the slender tail. The snout projects only moderately beyond the mouth, the preoral projection being about equal to the suborbital width, and less than the distance between the tip of snout and the front of the premaxillaries. The head is about half as wide as long; the width of the snout, across the suborbital ridges at the front of the orbits is contained 2.6 (to 2.8) times in the length of head; the distance between the lateral tubercles is equal to the length of the orbit (0.9 orbit in a paratype). The supranarial ridges are rather strongly arched in-

ward; the preopercular margin is arched evenly forward above the rounded angle; the oblique suborbital ridge is little curved downward; it extends from below the anterior nostril to below the hind margin of the orbit. The snout is equal in length to that of the round orbit, each being contained 3.7 times in the head (in all three specimens). The interorbital width is narrow, being contained 5.0 (4.65 to 6.0) times in the head; the least suborbital width is slightly less than half the orbital length. The moderately oblique upper jaw extends from below the lateral rostral tubercle to below the front edge of the pupil (to past vertical from center of eye in the smaller paratypes); its length is contained 3.4 (3.2 to 3.5) times in the head, being greater than the length of the snout. The outer series of teeth in the premaxillary band are stouter and more widely spaced than the others. The barbel is variable; it is slender in the type, in which it is contained 2.6 times in the orbit; slender in the paratype from station 5215, 2.4 in orbit; very thick and much longer in the other paratype, from station 5124, 1.6 in orbit. The gill-membranes are united without a free fold. Six branchiostegal rays. The slit before the first gill-arch is reduced, 3.5 in orbit; the gill-rakers are rudimentary.

Eight (or nine in a paratype) rows of scales separate the front of the second dorsal fin from the lateral line series (six below last ray of first dorsal fin); 18 rows of scales were counted from the lateral line downward and backward to the origin of the anal. The scales are reduced in size on the belly and on the head exclusive of the opercular region. The gular and branchiostegal membranes are wholly naked. The spinules on the scales are definitely arranged in parallel or subparallel series, and no definite quincunx order can be made out except on some of the scales on the head and on the back before the dorsal fin; each scale of the body bears about 15 (11 to 16) of these series. There are no carinae, as each spinule rises independently from the surface of the scale. The individual spinules are of subequal size and of conic form; the last one of each series projects a little beyond the margin of the scale. The conspicuous terminal rostral tubercle, of semispherical form, is armed with about eight radiating rows of strong spinules; the smaller lateral tubercles are of oval outline, with a less definite arrangement of the smaller spinules.

Six pyloric caeca were counted in one paratype, and eight in the other; they are shorter than the orbit in both cases. The anus is placed immediately before the anal fin; its center is located behind the base of the outer ventral ray a distance slightly less than the postorbital length of the head, and equal to the distance between the ventral base and the isthmus (somewhat longer in a paratype).

The first dorsal spine is sharp but short, the length of its external portion being one-seventh that of the orbit; its root is composed of two posterior condyles separated anteriorly by a socket, from which a foramen passes backward between the condyles; the exposed portion is of pyramidal form, with grooves between the four sharp angles. The first dorsal spine appears to be more than a rudiment: it probably serves as a support for the strong denticulated second spine. The heavy basal half of the second spine is triangular in cross-section, with the sides grooved; the sharp anterior keel bears 24 (20 or 30) strong spinules, becoming longer and more slender upwards, and confined to the basal 0.6 of the spine. The spine becomes very slender distally, and exceeds the length of the head by a distance contained 5.2 (2.4, 2.9) times in the head; the third ray is contained 1.1 (to 1.5) times in the head; all the soft rays of the first dorsal except the last two are branched in their distal half. The rays of the second dorsal are rudimentary anteriorly, and can not be traced so far forward in the type as in the paratype, the interdorsal space being 2.3 times the base of the first dorsal in the type, and 1.3 times that distance in the two paratypes. The pectoral fin is not produced, its length being contained 1.7 times in the head (1.4 times in a paratype); its fifth ray is longest. Ventral with 8 rays, the outer one filamentous and nearly as long as the head, reaching backward to the ninth anal ray; ventral inserted slightly behind the pectoral, but anterior to the dorsal.

The ground color is dusky brownish, becoming darker on the belly and on the head, particularly toward the snout; the sides of the belly and of the head are underlain with a silvery pigment; the lips, nasal fossa, and upper half of branchiostegal membranes are blackish. The fins are all blackish, with a little grayish pigment basally, overlying the darker shade. The base of the anal has a narrow whitish, punctulate streak. Lining of buccal cavity bluish black; of branchial cavity, brown, shading into black toward branchial aperture; parietal peritoneum dusky brown.

C. semiscaber belongs to a rather well-marked group of species which agree in possessing a produced dorsal spine, a deep and sharply compressed body, and a dorsal contour horizontal behind the first dorsal fin. It differs from all the other species of the group in the lower dorsal spine, and in numerous other details: from *C. marginatus*,[1] the Japanese representative, in the much darker color, less regular arrangement of the spinules on the scales, blunter head, more numerous serrations of the dorsal spine, etc.; from *C. microps*, in the more numerous ventral rays; much darker color; more numer-

[1] For description and synonomy see Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 164.

ous serrations on the dorsal spine; much larger eye, and blunter head; and from *C. macrolophus*,[1] in the larger eye, which is equal to the length of the blunter snout, instead of being much smaller, as in both adult (*C. macrolophus*) and young (*C. lophotes*), of the Indian Ocean species.

C. awae, of Japan, a member of the same group, appears to be a very distinct species, although the large type of that species probably differs widely from smaller specimens, judging from the known changes in *C. marginatus* and *C. microps*. It is possible that *awae* is based on a very large example of *marginatus*.

C. semiscaber is also closely related to the following species, *C. tydemani*, another member of the same group.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.	
Albatross station	5215	5215	5534
Total length in mm	251	213	[1]110
Length to anus in mm	74	65	28
Length of head	66	66	69
Length of orbit	18.5	18	19
Width of interorbital	13	14	15
Width of suborbital	8	7	8
Orbit of preopercle	23	24	31
Length of snout	18.5	18.5	----
Length of upper jaw	20	20	21
Length of barbel	6	7	9
Depth of body	49	55	46
Width of body	27	27	30
Anus to ventral	29	30	31
Ventral to isthmus	29	27	27
Height of second dorsal spine	78	88	----
Height of third dorsal ray	52.5	----	----
Length of base of first dorsal	20	21.5	19
Length of pectoral	39	40.5	----
Length of outer ventral ray	62	63	51
Length of second ventral ray	26	26	----

[1] A small pseudocaudal developed.

(*semiscaber*, in reference to the basal armature of the dorsal spine.)

15. CORYPHAENOIDES TYDEMANI (Weber).

Macrurus tydemani Weber, Fische der *Siboga*-Expedition, 1913, p. 158, pl. 1, fig. 6.

Four specimens of this fine species were dredged at *Albatross* station 5648, in Buton Strait, near Celebes, at a depth of 559 fathoms; bottom temperature, 39.2° F.

There is included a complete description of our material for comparison with *C. semiscaber* and other related species.

Fin-rays—first dorsal, II, 9 or 10; pectorals, 20 to 22; ventrals, 8 (8—9 in one).

The shape of the body and the course of the contours being similar in all respects to those of *C. semiscaber*, a repetition of the description seems unnecessary.

[1] See the note after the description of the next species.

Snout, 3.4 to 3.5 in head, longer than the orbit, the greatest length of which is contained from 4.0 to 4.2 times in the head. The interorbital is subject to considerable variation, as in *C. semiscaber*, its least width being contained 4.1 to 5.5 times in the head. The least suborbital width is half the length of the orbit. The mouth is somewhat oblique; the maxillary extends from below the lateral rostral tubercle to the vertical passing through the center of the orbit; length of upper jaw, 3.3 to 3.4. The teeth in both jaws are in moderate villiform bands; the teeth in the outer premaxillary series are somewhat heavier and more widely spaced than those in the remainder of the band. Barbel variable in strength, 2.4 to 3.9 in orbit. The gill-membranes are united, without a free fold. Six branchiostegals. The slit before the first gill-arch is greatly reduced, being contained only 4.0 to 4.5 times in the orbit. Eight rows of scales separate the origin of second dorsal from the lateral line scales; somewhat farther back a ninth row is inserted along the dorsal base; there are six or seven rows between the last ray of the first dorsal and the lateral line. The scales are smaller on the belly, and on the head with the exception of the opercular region. The gular and branchiostegal membranes, and the shoulder girdle beneath the opercles, are wholly devoid of scales. The spinules on the scales are not so definite in their arrangement as in *C. semiscaber;* a quincunx order can be made out on most of them; the spinules are aligned in about 15 series which converge more or less rapidly toward the apex of the scale; the spinules are of subequal size and conic form; the last one projects beyond the margin of the scale. The terminal rostral tubercle is rather small, and is armed with conic spinules of moderate strength, and not definitely arranged in series; the lateral tubercles are weak but distinct.

Ten pyloric caeca, about as long as the orbit, were counted in one specimen. The anus lies immediately in advance of the anal fin. The distance between the base of the outer ventral ray and the center of the anus is equal to, or greater than, the postorbital length of the head; the distance between the ventral fin and the isthmus is only 0.7 to 0.8 the postorbital length of the head.

The first dorsal spine is short and slender; the second spine is produced into a strong, compressed, and exceedingly long filament; the entire length of the spine is much greater than the length to the anus, being considerably more than half the length of the fish (except in the largest specimen); the anterior keel of the spine bears only 11 or 12 denticulations of moderate strength, confined to a basal portion of the spine contained 7.4 times in its entire length, and 2.5 to 3.0 times in the head; the length of the head is

contained 2.82 to 3.05 times in the spine (only 2.0 times in the largest specimen). The third ray of the first dorsal is contained from 1.05 to 1.25 times in the head. The base of the first dorsal fin contains the length of the snout from 1.0 to 1.2 times, and itself is contained from 1.0 to 1.25 times in the interval between the end of the first dorsal and the first of the small anterior rays of the second dorsal. The length of the pectoral fin is contained 1.5 times in the head; it is not produced, but somewhat pointed, the fifth ray being longest. The filamentous outer ventral ray, reaching at most to the fifth anal ray, is contained 1.35 to 1.6 times in the head; its insertion is slightly behind the vertical from the origin of the first dorsal.

The ground color in alcohol is light yellowish brown, becoming duller on the belly and head, darker on the snout and opercle. The margins of the mouth, the edges of the nostrils, the eye, and the branchiostegal membranes opposite the opercle, are blackish. The sides of the head and the belly are underlain with silvery. The fins are blackish, becoming lighter basally. The lining of the buccal and branchial cavities is blackish; the parietal peritoneum is brownish.

C. tydemani differs from the other species of the same group (as defined after the description of the last species) as follows: from *C. marginatus*, in the smaller eye, darker color, and arrangement of spinules on the scales; from *C. microps*, in the larger eye, more numerous ventral rays, darker color, and in the arrangement of the spinules on the scales; and from specimens of *C. macrolophus* (Alcock)[1] of similar size, in the much longer dorsal spine, with fewer serrations, and in the smaller scales; both Alcock and Brauer counted 5 or 6 scales from the end of the first dorsal to the lateral line, including the lateral line scale; while *C. tydemani* has 7, exclusive of the lateral line scale. *C. tydemani* is closely related also to *C. semiscaber*, from which species it differs as follows:

Snout longer than orbit, instead of being equal to it, and contained 3.4 to 3.5 instead of 3.7 times in the length of the head.

2. Orbit shorter, 4.0 to 4.2 (to 5; Weber) instead of 3.7.

3. Spinules on scales less regularly arranged in parallel series, it being possible to align them in quincunx order.

4. The rostral tubercles smaller; the spinules on the terminal tubercle weaker and not arranged in definite radiating series.

5. The distance is greater between the anus and the base of the ventrals, and shorter between the base of the ventrals and the isthmus.

6. The second dorsal spine is stronger and very much longer, and is armed with fewer serrations, which are confined much more closely to the basal portion of the spine.

[1] See note on *C. macrolophus*, after the description of this species.

7. The interdorsal space appears to be shorter, 1.0 to 1.25, instead of 1.3 to 2.3, times as long as the first dorsal base.

8. The ventral filament is weaker, and shorter.

9. The color, especially of the fins, is a little lighter.

The slight difference in size between our specimens of the two species renders wholly improbable any assumption that these differences may be due to age variation. Furthermore, the dorsal spine usually decreases in length with age in the species of this long-spined group, and such appears to be the case with *C. tydemani*, but *C. semiscaber*, though represented by smaller specimens, has a much shorter spine.

Table of measurements in hundreths of length to anus.

Albatross station	5648	5648	5648	5648
Totallength in mm	288+	369	[1] 268	258+
Length to anus in mm	94	87	85	80
Length of head	63	64	58	66
Length of orbit	16	15.5	16	15
Width of interorbital	15	12	14.5	12
Length of suborbital	8	8.5	8	9
Orbit to preopercle	25	27	23	28
Length of snout	18.5	19.5	17.5	18
Length of upper jaw	19	19	17.5	20.5
Length of barbel	5	6	4	6
Depth of body	54	51	52	.....
Width of body	31	25	27	30
Anus to ventral	33	32	38.5	32
Ventral to isthmus	23	24.5	23	25
Height of second dorsal spine	127	182	.....	198
Height of third dorsal ray	52	52.5	52	63
Length of first dorsal base	19	19.5	20	21.5
Length of pectoral	39	41	41	43
Length of outer ventral ray	45	47	45	42
Length of second ventral ray	21	23	22	23

[1] A small pseudocaudal developed.

Note on CORYPHAENOIDES MACROLOPHUS (Alcock).

Macrurus macrolophus Alcock, Ann. Mag. Nat. Hist., Nov. 1889, p. 394; August, 1891, p. 121; Nov., 1892, pp. 351, 352, fig. 1; Journ. Asiatic Soc. Bengal, vol. 63, pt. 2, 1894, p. 126; Illustrations of the Zoology of the *Investigator*, Fishes, pl. 12, fig. 1, 1894; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 115.

Macrurus macrolophus Brauer, Die Tiefsee-Fische, 1906, p. 266.

Macrurus lophotes Alcock, Ann. Mag. Nat. Hist., Nov., 1889, p. 385; Journ. Asiatic Soc. Bengal, vol. 43, pt. 2, 1894, p. 126; Illustrations of the Zoology of the *Investigator*, Fishes, pl. 3, fig. 2, 1894; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 116.

Brauer considers *C. lophotes* to be the young of *C. macrolophus*, a conclusion which is apparently justified. But inasmuch as Brauer states that most of his specimens have seven branchiostegal rays, it is highly probable that he had, in part at least, a species of another genus, as all specimens of *Coryphaenoides* examined by us have constantly six branchiostegal rays.

C. macrolophus is not represented in the Philippine collection. Radcliffe's[1] reference to Philippine specimens should apply to *C. semiscaber* and to *C. tydemani*.

[1] Proc. U. S. Nat. Mus., vol. 43, 1912, p. 117.

16. CORYPHAENOIDES MICROPS (Smith and Radcliffe).

Macrourus microps SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 116, pl. 25, fig. 2.

List of stations.

Albatross station.	Locality.	Depth, in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5325	Off northern Luzon	224	53.2	4
5470	Lagonoy Gulf, southeastern Luzon	560	.....	Type.

A series of eight or nine scales separates the origin of the second dorsal fin from the lateral-line series.

Measurements of the large type follow: Length of orbit, 6.0 in head, 1.7 in snout, 1.15 in interorbital width, 5.2 in head; length of snout, 3.7.

The small specimens, four in number, differ in several respects so widely from the type-specimen that one might be led to separate them as a distinct form. On the basis of the limited material, and especially because the variations are partly paralleled in the growth of *C. marginatus*,[1] we regard the differences between them as being due to age variations. The differences in proportion are well indicated in the table of measurements. Further differences are listed below:

1. The number of parallel rows of spinules on the scales is fewer in the smaller specimens (a very similar variation occurs in *C. marginatus*, the closely related Japanese species).[1]

Length to anus in mm.	Number of rows of spinules.
33	3
53	6 to 8
66	8 to 11
150 (type).	13 to 21

2. The number and strength of the serrations on the second dorsal spine apparently decrease with the age of the fish, as in *C. marginatus*.[1] They are very weak in the type-specimen.

Length to anus in mm.	Number of serrations, mm.
33	16
ca. 37	12
53	11
66	11
150 (type).	4

3. The first dorsal spine is comparatively strong and sharp in the smallest specimen, becoming progressively weaker in the larger specimens, being rudimentary in the large type. This variation is normal.

[1] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 165.

4. The second dorsal spine, as in *C. marginatus*, seems to be the longest in the medium-sized specimens (see the following table of measurements).

5. The terminal rostral tubercle is relatively much smaller in the large type than in the smaller specimens.

6. The coloration of the smaller specimens, perhaps to be correlated with their capture at a lesser depth, is much lighter, especially on the fins, than in the larger type. The fact that the largest of the paratypes is much lighter than the other three renders less significant the color difference between the type and the paratypes. In this lightest specimen the fins are white, with the exception of the following parts: the ventral filament, the tips of the anterior anal rays, the second dorsal spine, and the distal portions of the first few rays of the anterior dorsal.

The buccal cavity is lined with dusky; the branchial cavity with blackish; the peritoneal cavity with brownish.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.			
Albatross station	5470	5325	5325	5325	5325
Total length in mm	[1] 430	[1] 183	[2] 172	.....	.....
Length to anus in mm	150.	66	53	ca. 37	33
Length of head	57	62	63	.....	.....
Length of orbit	10	13	14	.....	14
Width of interorbital	11. 5	12	12	.....	13
Width of suborbital	8	8	9	.....	.....
Orbit to preopercle	25	28	29	.....	.....
Length of snout	16	18	19	.....	.....
Width of snout	19. 5	23	26	.....	22
Length of upper jaw	17	20	20	.....	20
Length of barbel	5	6	6	.....	.....
Depth of body	53	47	49	.....	54
Width of body	23	28	28	.....	26
Anus to ventral	.....	29	27	.....	.....
Ventral to isthmus	27	26	26	.....	.....
Height of second dorsal spine	122. 5	177. 5+	.....	ca. 250	152
Height of third dorsal ray	45	59	.....	.....	.....
Length of first dorsal base	18	19	19	.....	.....
Interdorsal space	[3] 35	10	21	.....	.....
Length of pectoral	36	38	39	.....	33
Length of outer ventral ray	29	37	39	.....	38
Length of second ventral ray	19	24	26	.....	.....
Soft rays, first dorsal	9	10	9	9	9
Pectoral rays:					
Left	20	20	21	.....	.....
Right	.....	20	21	.....	.....
Ventral rays:					
Left	7	8	7	7	7
Right	7	8	7	7	8

[1] A large pseudocaudal developed around the truncated end of tail (see type-figure).
[2] A small pseudocaudal developed.
[3] The rudimentary rays of the second dorsal can be traced farther forward by dissection.

(*microps*, in reference to the very small eye.)

17. CORYPHAENOIDES AEQUATORIS (Smith and Radcliffe).

Macrourus aequatoris Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 120, pl. 26, fig. 3.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
[1] 5608	Gulf of Tomini, Celebes	1,089	36.3	1
5609	.....do	1,092	36.3	1

[1] Type.

The head, as usual, is deeper than wide, the erroneous statement to the contrary in the type description being due to the abnormal inflation of the sides of the head. A few proportions follow: length of orbit, 3.8 in head; length of snout, 3.6 (3.8); least interorbital distance, 4.1; length of upper jaw, 3.3; length of barbel, 0.6 length of orbit (in specimen from station 5609). A triangular portion of the interopercle is visible above and behind the rounded, denticulate margin of the preopercle; the ridge of the preopercle is produced backward as a rounded lobe. Number of branchiostegal rays, 6. Five rows of scales occupy the region between the lateral line series and the front of the second dorsal.

The ventral fins are inserted well behind the pectorals, directly below the origin of the first dorsal. The distance between the insertion of the ventrals and the center of the anus is very short, being about equal to the length of the snout, and shorter than the distance between the ventral base and the isthmus.

The buccal cavity is lined with dusky, but is lighter behind the corners of the mouth; the branchial and abdominal cavities are lined with bluish black.

The type-figure, referred to above, is rather inaccurately drawn; the snout is represented too long, and the ventral fins are inserted too far forward.

This aberrant species is certainly not closely related, as Radcliffe was led to believe, to *Macrurus petersonii* Alcock, a species which inhabits comparatively shallow water and belongs to a genus quite distinct, namely *Ventrifossa*.

Table of measurements in hundredths of length to anus.

	Type.	Paratype.
Albatross station	5608	5609
Total length in mm	[1] 188	166+
Length to anus in mm	62	55
Length of head	70	70
Length of orbit	18	19
Width of interorbital	17	18
Width of suborbital	11	11
Orbit to preopercle	31.5	32
Length of snout	20	20
Length of upper jaw	22	22
Length of barbel	11	13
Depth of body	51	57
Width of body	53	.....
Anus to ventral	22	21
Ventral to isthmus	27.5	30
Length of first dorsal base	18	18
Length of pectoral	34	30
Length of outer ventral ray	62	63
Length of second ventral ray	25	.....

[1] A small pseudocaudal developed.

(*aequatoris*, in reference to the type locality, which is nearly under the equator.)

18. CORYPHAENOIDES ORTHOGRAMMUS (Smith and Radcliffe).

Macrourus orthogrammus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 123, pl. 27, fig. 3.

This species is a very distinct one, having no close allies. It differs generically from *Lionurus parvipes* and *Mataeocephalus*, with which its describers compared it, in the number of branchiostegal rays, of which there are 6 instead of 7.

C. orthogrammus is known only from the type-specimen dredged from 1,262 fathoms, by the *Albatross*, at station 5636 near Gomomo Island, in Pitt Passage, Dutch East Indies.

The width over the pectoral bases is but half the greatest depth of the body. The length of the orbit is contained 4.2 times in the head; the width of the wide, flat interorbital space, 3.4 times. The prominent supranarial ridges are arched inward. The sides of the head are parallel, not diverging posteriorly; the distance between the lateral terminal tubercles is equal to the interorbital width. Length of the upper jaw, 3.3. The denticulate margin of the preopercle is produced backward in a wide curve, which nearly covers the posterior lobe of the interopercle. The preopercular ridge is sharply produced backward.

The scales are in five series between the origin of the second dorsal and the lateral line series.

The ventral fin is inserted directly below the origin of the first dorsal and the base of the pectoral, at a distance from the center of the anus equal to the interorbital width, and at a distance from the isthmus equal to the length of the snout.

The lining of the buccal cavity is dusky; of the branchial cavity, bluish black; of the abdominal cavity, brownish black.

Measurements in hundredths of length to anus (48 mm.)—Length of head, 74; length of orbit, 17; width of interorbital, 22; width of suborbital, 10; orbit to preopercle, 33; length of snout, 25; length of upper jaw, 24; length of barbel, 2.5; depth of body, 49; width of body, 26; length from anus to ventral, 22; from ventral to isthmus, 26; length of first dorsal base, 19; length of outer ventral ray, 50.

(*orthogrammus*, perhaps in reference to the strongly marked line formed by the suborbital ridge.)

19. CORYPHAENOIDES CAMURUS (Smith and Radcliffe).

Macrourus camurus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 122, pl. 27, fig. 2.

This remarkably peculiar species is known only from the small type, dredged at *Albatross* station 5428, off eastern Palawan, at a depth of 1,105 fathoms and at a bottom temperature of 49.7° F.

The width across the pectoral bases is distinctly less than half the depth of the body below the origin of the first dorsal. Orbit, 3.2 in length of head; interorbital width, 3.3; snout, 3.9; length of upper jaw, 2.6. The preopercular ridge is produced backward at its angle more strongly than is the preopercular margin; only the tip of the rather acute posterior lobe of the interopercle is visible behind the preopercular margin. Six branchiostegal rays.

The lateral line is indicated on the sides by the presence of several scales with pores at a distance below the origin of the first dorsal less than one-fourth that to the ventral surface. The type-description indicates that its position was interpreted too low. There are about eight scales in a series from the origin of the second dorsal to, but exclusive of, the lateral line scales.

The ventral fin is inserted below the pectoral base, slightly anterior to the origin of the first dorsal; its distance from the anus is equal to the length of the upper jaw, and is less than its distance from the isthmus.

The lining of the buccal cavity is blackish; that of the branchial and abdominal cavities, black.

Measurements in hundredths of length to anus (29.5 mm.).—Length of head, 68; length of orbit, 21; width of interorbital, 22; width of suborbital, 11; orbit to preopercle, 34; length of snout, 19; length of upper jaw, 27; length of barbel, 20; depth of body, 63; width of body, 29; length from anus to ventral, 29; from ventral to isthmus, 30; length of first dorsal base, 18.

(*camurus*, crooked; in reference to the peculiar physiognomy.)

A. CORYPHAENOIDES, species.

Coryphaenoides, species, Weber, Fische der *Siboga*-Expedition, 1913, p. 154.

There is little doubt that the species of *Coryphaenoides* thus noted by Weber is an undescribed form; it certainly is not included in the collections of the *Albatross*.

Hyomacrurus, new subgenus.

Type-species.—*Macrourus hyostomus* Smith and Radcliffe.

Distinguished by the anterior position of the anus.

20. CORYPHAENOIDES HYOSTOMUS (Smith and Radcliffe).

Macrourus hyostomus Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 121, pl. 27, fig. 1.

The collection contains six specimens of this interesting species, in addition to the type described by Radcliffe.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° F.	
5460	Off east coast of Luzon	565		1
5467	do	480		2
5470	do	560		Type.
5587	Near Sibuko Bay, Borneo	415	43.3	1
5648	Buton Strait, near Celebes	559	39.2	2

This remarkable species strikingly differs from all others referred by us to *Coryphaenoides* in the anterior position of the anus, which is located well in advance of the anal fin. But it has six branchiostegal rays, and its reference to *Coryphaenoides* is corroborated by the entire appearance of the fish. *Macrurus heyningeni* Weber,[1] a species recently described from the East Indies, is described as having six branchiostegal rays and the anus remote from the anal fin. It probably is a species of *Coryphaenoides*, but certainly is not *C. hyostomus*.

The orbit of the type-specimen is contained 4.3 times in the head, 1.3 times in the snout, and 1.0 times in the interorbital space. In the other specimens the orbit is contained 4.05 to 4.4 times in the head, 1.2 to 1.4 times in the snout, and in some slightly exceeds in length the least interorbital width. The large flap which covers the anterior nostril in the type is not constantly enlarged. The mouth, as usual in the genus, is U-shaped, and longer than broad; the statement to the contrary, in the type description, is due to the frequent distortion of the head, which throws outward the walls of the branchial cavity. The suborbital ridge is especially well developed, extending backward beyond the orbit, but not to the preopercle; the total length of the ridge is equal to that of the mandible. The tip of the snout is armed with short but robust spinules which display no definite order in their arrangement; the lateral rostral tubercles are indistinct. The slit before the first gill-arch is 0.3 as long as the orbit. There are 5 or 6 rows of scales between the origin of the second dorsal and the lateral line, excluding the scale perforated by the lateral line.

The dorsal spine bears 3 to 5 indistinct or small serrations on its anterior edge, confined to a basal portion containing the length of the orbit 1 to 1.8 times. The head is contained 1.88 times in the dorsal spine in the type, 2.02, 2.08, 2.17, 2.63+, and 2.83 times in five of the other specimens. First dorsal, II, 9 in all specimens but one, which has 8 soft rays; ventral fin with 8 rays in all cases; pectoral rays, 17 to 20.

[1] Die Fische der *Siboga*-Expedition, 1913, p. 156, pl. 5, fig. 3.

The lining of the buccal and branchial cavities is blackish, except along the margin of the mouth; the peritoneum is blackish brown, underlaid with silvery.

Table of measurements in hundredths of length to anus.

Albatross station	5202	5648	5467
Total length in mm	280+	[1] 273	[1] 259
Length to anus in mm	82	82	71
Length of head	73	72	74
Length of orbit	18	18	18
Width of interorbital	17	18	16.5
Width of suborbital	11	11	11
Orbit to preopercle	29	30	29
Length of snout	24	23	25
Width of snout	29	27	28
Length of upper jaw	22	20	21
Length of barbel	7	5	6
Depth of body	46	46	47
Width of body	31	34	29
Anal to anus	13	13.5	15
Anus to ventral	18	21	20
Ventral to isthmus	22	23	23
Height of second dorsal spine	139	146.5	163
Height of third dorsal ray	56.5	57	----------
Length of first dorsal base	18	17	17
Length of interdorsal space	13.5	16	14
Length of pectoral	38	22.5	----------
Length of outer ventral ray	43	40	31
Length of second ventral ray	26	27	22

[1] A pseudocaudal developed.

(*hyostomus*, meaning hog-mouth.)

Genus COELORHYNCHUS Giorna.

The fauna of the Philippine Islands and the adjacent region to the southward has proved to be exceptionally rich in the species of *Coelorhynchus*. The region appears to be the center of their distribution, for in no other similar area in any of the seas is there known anything like the variety of species which occurs there. Of special note are the numerous species of the *C. notatus* and the *C. japonicus* groups. The subgenus *Quincuncia* is unknown elsewhere. In this region there are now known 23 species, or 45 per cent, of the total number in the world.[1] Despite the occurrence of this large number of species, none of them, with the exception of *C. parallelus*, has been discovered in other faunal regions, although some of them have close representatives in the Indian, Japanese, and Hawaiian faunas. These facts of distribution have already been discussed in the introduction.

The following analytical key has been arranged, as far as possible, to indicate the mutual relationships of the subgenera and species, each one being most closely related to the group or species preceding and following it.

[1] The authors have examined 42 of the 51 known species.

ANALYTICAL KEY TO THE SUBGENERA AND SPECIES OF COELORHYNCHUS.[1]

A^1. Teeth in the lower jaw biserial or nearly so, at least on the sides; scales little strengthened on the weak ridges of the head; subopercle angulated at posteroventral angle, but without a distinct flap.

B^1. Teeth biserial in both jaws; anus remote from anal, and preceded by a single large naked fossa covering a glandular body not supported by a rod of cartilage; scales well imbricate, armed with spinules on strong divergent carinae; anterior portion of eyeball scaled; one Japanese species_____ABYSSICOLA *macrochir.*

B^2. Teeth in a cardiform band in upper jaw; anus posterior in position, immediately in advance of anal; anus preceded by a long cylindrical organ with a dilation immediately before the anus, and another, before the ventral fins, supported by an arched rod of cartilage connected with the pubic bone; scales poorly imbricate, armed with spinules arranged in quincunx order; eyeball wholly naked; three East-Indian species_____QUINCUNCIA.

a^1. Underside of head naked; five or six series of scales between lateral line and origin of second dorsal; distance from anus to base of ventral in head, 1.8 to 2.3; distance from anus to isthmus in head, 1.15 to 1.32_____*argentatus.*

a^2. Underside of head scaled; four series of scales between lateral line and and origin of second dorsal; distance from anus to base of ventral in head, 2.4 to 3.5.

b^1. Rami of mandibles scaled; front of premaxillaries below middle of nasal fossa; distance from anus to isthmus in head, 1.32 to 1.6; numerous proportions of fins and of parts of head generally like those of *C. argentatus* (see p. 445)_____*quincunciatus.*

b^2 Rami of mandibles nearly scaleless; front of premaxillaries below posterior nostril; distance from anus to isthmus in head, 1.6 to 2.0; numerous proportions of fins and of parts of head different from those of *C. argentatus* and *C. quincunciatus* (see p. 445) *thompsoni.*

A^2. Teeth of both jaws in villiform bands (sometimes reduced in the lower jaw to scarcely more than three series in the subgenus *Oxygadus*).

B^1. Subopercle with posteroventral angle rounded; snout little produced; physiognomy much as in *Quincuncia,* the ridges of head weakly armed; anus never in advance of normal position just before anal fin; height of first dorsal fin less than postrostral length of head; a closely related group of six species known only from the Atlantic Ocean and the Eastern Pacific_____COELORHYNCHUS.

a^1. Spinules on scales arranged in quincunx order, without a median series; no prominent median occipital scaly ridge; species of the North Atlantic.

b^1. Median scale of terminal rostral tubercles not so strong as the lateral pair; scaleless ventral fossa elongate, one-third as wide as long.

c^1. Scales with smaller spinules; no prominent spot on first dorsal; no dark barks on body; a species of the eastern Atlantic_____ *coelorhynchus.*

[1] We include all of the known species with the exception of *C. labiatus* (Koehler), the original description of which is not available to us.

c^2. Scales rougher; first dorsal with a blackish median spot; a dark bar above the lateral line below origin of second dorsal (sometimes indistinct); a species of the western Atlantic_____ *carminatus.*

b^2. Median scale of terminal rostral tubercles much more produced than the lateral pair; scaleless ventral fossa shield-shaped, two-thirds as wide as long; a species of the western Atlantic_____ *caribbaeus.*

a^2. Spinules on scales arranged in definite series; a median occipital scaly ridge present; species of the eastern Pacific and Patagonia.

b^1. Spinules on scales in subparallel series; species of the eastern Pacific.

c^1. Spinules weak, the median series not enlarged; five rows of scales between lateral line and origin of second dorsal; a species from Panama_____ *canus.*

c^2. Spinules strong, with an enlarged median series; six rows of scales between lateral line and origin of second dorsal; a species from the Gulf of California_____ *scaphopsis.*

b^2. Spinules on scales in an enlarged median series and divergent lateral series; four rows of scales between lateral line and origin of second dorsal; a species from Patagonia_____ *patagoniae.*

B^2. Subopercle with a conspicuous acute flap on its posterior margin; snout variable, but usually very long; ridges of the head strong, and armed with thickened, highly specialized scales.

C^1. Spinules on scales on parallel or subparallel carinae of equal strength; anus usually in advance of normal position just before anal fin; height of second dorsal equal to, or greater than, postrostral length of head;[1] body with definite dark markings;[2] an apparently natural group of small species of the south and west Pacific[3]_PARAMACRURUS.

a^1. Under side of head completely scaled; Australian species.

b^1. Eye longer than snout; occipital ridges very weak; boundaries of scales on head indistinct; 8 rows of scales above lateral line; interdorsal space one-third as long as base of first dorsal; dark bars extending obliquely forward_____[4] *aspercephalus.*

b^2. Eye shorter than snout; occipital ridges stronger; boundaries of scales on head distinct; 5 rows of scales above lateral line; interdorsal space equal to length of first dorsal base; dark bars extending obliquely backward _____ *australis.*

a^2. Under side of head completely scaleless;[5] species of the Japanese, Hawaiian, and Philippine faunas (with the exception of *C. fasciatus* and *C. innotabilis*).

c^3. Snout much shorter than the very large orbit; a subantarctic species_____ *fasciatus.*

c^2. Snout scarcely if any shorter than the orbit, usually longer.

d^1. A round blackish spot always present just above and behind pectoral fin; second dorsal fin much lower anteriorly than anal.

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[1] Except in *C. innotabilis*, known only from young type; character unknown in *C. cingulatus.*

[2] Except in *C. innotabilis.*

[3] *C. fasciatus* has been recorded from South Africa.

[4] We are uncertain as to the relationships of this peculiar species. It possibly does not belong to this genus.

[5] This statement has been verified by examination of all the species included in group a^2, with the exception of *C. innotabilis*, which is not closely related to either *C. aspercephalus* of *C. australis.*

e^1. Snout less than twice as long as orbit; 4 to 6½ scales in a series from origin of second dorsal to lateral line; first dorsal not black distally; species of the Japanese and East Indian faunas.

f^1. Snout about as long as orbit; species of the Japanese fauna.

g^1. A scaleless ventral fossa present, between ventrals, separated by a scaly bridge from the peritroct; pyloric caeca 19 to 23; pectoral longer and stronger, with 17 rays; orbit longer than postorbital length of head; body with a large round spot above and behind pectoral, and another below anterior part of second dorsal_____*kishinouyei.*

g^2. No scaleless ventral fossa; pyloric caeca 25 to 31; pectoral shorter and weaker, with 14 to 15 rays; orbit shorter than postorbital length of head; body with a smaller anterior spot and no posterior spot_____*jordani.*

f^2. Snout decidedly longer than orbit; species of the East Indian fauna.[1]

h^1. A scaleless ventral fossa extending from between ventrals to the peritroct, widest anteriorly; dorsal spine produced into a long filament.

i^1. Dorsal contour of snout straight; sides of snout strongly and evenly convex, without prominent anterolateral angles; color darker, the two posterior saddle-like markings rather indistinct, not ocellated; ventral rays, 7; distance from anus to anal, 2.0 to 4.0 in distance from anus to ventral.

j^1. Five or fewer very strongly spinous carinae on scales; snout longer, its preocular length 2.3 to 2.7 in head; anterolateral region of snout naked; interorbital broader, its least width 1.3 to 1.6 in postorbital; body more slender, its greatest depth 1.8 to 1.95 in head; color darker, rays of first dorsal light near base_____*maculatus.*

j^2. Five to 11 much smoother carinae on scales; snout shorter, its preocular length 2.75 to 2.95; anterolateral region of snout largely prickly; interorbital narrower, 1.55 to 1.85 in postorbital; body more robust, its greatest depth 1.6 to 1.7 in head; color lighter; rays of first dorsal dark near base__*velifer.*

i^2. Dorsal contour of snout concave; sides of snout not strongly convex, with prominent anterolateral angles; 7 to 12 carinae on scales; least interorbital width 1.55 to 1.85 in postorbital; greatest depth of body 1.7 to 1.9 in head; color lighter; first dorsal whitish proximally.

k^1. Tho two posterior saddle-like markings rather indistinct, not ocellated; pectoral rays, 14 or 15; ventral rays, 6; anterolateral portion of snout with a few scales posteriorly; scaleless ventral fossa longer, extending forward to between front of ventral bases; preocular length of snout 2.48 to 2.6 in head; preoral

[1] Many diagnostic details, especially in characters of the head scales, the coloration, etc., are not included in the key, but may be found in the body of the descriptions.

length, 2.9 to 3.05; orbit, 3.5 to 3.9 in head, 1.3 to 1.55 in snout; maxillary, 3.7 to 4.05 in head; distance from anus to anal, 2.9 to 3.7 in distance from anus to base of outer ventral ray_____*sexradiatus.*

k^2. Two posterior saddle-like markings very distinct, strikingly ocellated; pectoral rays, 16 or 17; ventral rays, 7; anterolateral portion of snout largely prickly; scaleless ventral fossa shorter, extending forward only to opposite posterior end of ventral bases.

l^1. Snout shorter and blunter, its preocular length 2.71 in head; its preoral length 3.0; orbit, 3.4 in head; 1.28 in snout; maxillary, 3.75 in head; distance from anus to anal, 1.6 in distance from anus to base of outer ventral ray_____*notatus.*

l^2. Snout much longer and sharper, its preocular length 2.32, its preoral length 2.45, in head; orbit, 3.6 in head, 1.6 in snout; maxillary, 4.5 in head; distance from anus to anal, 2.6 in distance from anus to base of outer ventral ray_____*triocellatus.*

h^2. No scaleless ventral fossa in region anterior to peritroct; dorsal spine produced into a long filament in only one species (*C. dorsalis*).

m^1. Dorsal contour of snout convex; orbit smaller, 3.3 to 3.8 in head, shorter than postorbital; snout narrower, its width at base 2.7 to 3.05 in head; interorbital narrower, 1.5 to 1.8 in postorbital; suborbital narrower, 2.6 to 2.7 in postorbital; 5½ or 6½ scales above lateral line; carinae on scales well developed; anterolateral region of snout largely prickly.

n^1. Second dorsal spine produced into a filament, about as long as head; 6½ scales in series above lateral line; snout more strongly convex laterally, the distance between the prominent anterolateral angles greater than distance anterior to them_____*dorsalis.*

n^2. Second dorsal spine without filament, much shorter than head; 5½ scales in a series above lateral line; snout less strongly convex laterally; the distance between anterolateral angles less than the distance anterior to them_____*argus.*

m^2. Dorsal contour of snout straight; orbit larger, 3.05 to 3.3 in head, longer than postorbital; interorbital, 1.3 to 1.5 in postorbital; suborbital, 2.0 to 2.3 in postorbital; 4½ scales in a row above lateral line series; carinae on scales obsolescent; anterolateral region of snout largely scaleless; dorsal spine not filamentous_____*macrolepis.*

e^2. Snout more than twice as long as orbit; 7½ scales in a series between origin of second dorsal and the lateral line scales; first dorsal fin black distally; second dorsal fin as high anteriorly as the anal; one Hawaiian species_____*gladius.*

d^2. No round blackish spot above and behind the pectoral fin; second dorsal fin as high anteriorly as the anal.

$o.^1$ Snout, 2.2 in head; orbit, 3.7; least interorbital width, 1.2 in orbit; interdorsal space two-thirds as long as the first dorsal base; body conspicuously mottled anteriorly, barred posteriorly; one species from northern Luzon and Formosa. *cingulatus.*

o^2. Snout, 2.4 in head; eye, almost 3 in head; interorbital width 1.8 in orbit; interdorsal space one-third as long as base of first dorsal; body without dark markings; one Australian species ..... *innotabilis.*

C^2. Spinules on scales on strongly divergent carinae, the lateral ones of which are often weaker than the median; anus always immediately before anal fin; second dorsal spine equal to, or less than, the postrostral length of head; body usually without definite dark markings; an apparently natural group of species, with its center of distribution in the East Indies ..... OXYMACRURUS.

a^1. Orbit very large, longer than the postorbital length of head; 3 to 5 spinous ridges on scales; distance from anus to ventral greater than length of orbit; snout comparatively short; one Chilean species ..... *chilensis.*

a^2. Orbit moderate, shorter than postorbital length of head; Indo-Asiatic species.

b^1. Snout less than twice as long as orbit in adult.

c^1. Snout without an acuminate tip; sides of snout very convex, the width between its anterolateral angles 0.75 or 0.8[1] in length before that point; scales on ridges of head, especially on infraorbital ridge, enlarged and strengthened much more than usual in this subgenus; flesh soft (*platorhynchus* group).

d^1. Underside of head and lower part of nasal fossa scaled; 5 to 7 strong spinous carinae on scales of body; scales from top of head usually with a single strong median keel; 4½ rows of scales in a series between lateral line and origin of second dorsal; infraorbital ridge scales in a double series on suborbital and preopercular regions, that is, behind middle of eye; area between ridge and orbit covered by small scales; orbit 1.2 to 1.25 in postorbital length of head; least interorbital width shorter than length of orbit, 1.5 to 1.7 in postorbital; preoral length of snout, 2.9 to 3.3 in head; length of maxillary, 3.8 to 4.1 ..... *platorhynchus.*

d^2. Underside of head and nasal fossa completely naked; scales from top of head usually with several carinae.

e^1. Four to seven strong spinous carinae on scales of body; 4½ rows of scales between lateral line and origin of second dorsal; infraorbital ridge scales in a double series on preopercular, suborbital, and posterior part of preorbital regions, that is, behind front of eye; area between ridge and orbit naked; orbit, 1.15 in postorbital length of head; least interorbital width decidedly shorter than length of orbit, 1.5 to 1.6 in postorbital; preoral length of snout, 2.9 to 3.05 in head; length of maxillary, 3.9. *acantholepis.*

[1] 0.85 in a young specimen of *C. acantholepis* 60 mm. long to anus.

e^2. Seven to ten weakly spinous carinae on scales of body; scales of head with lower and more numerous carinae; 5½ rows of scales between origin of second dorsal and lateral line, excluding lateral line series; infraorbital ridge scales in a double series only on preopercular region of ridge; area between ridge and orbit with scales of reduced size; orbit, 1.33 in postorbital length of head, equal to least width of interorbital, which is contained 1.3 times in postorbital; preoral length of snout, 3.5 in head; length of maxillary, 3.55 ..... *carinifer.*

c^2. Snout with its tip more or less acuminate; sides of snout less convex, sometimes nearly straight; the width between its anterolateral angles less than 0.85 in length before that point, usually much less; scales on ridges of head less strengthened than in *platorhynchus* group; flesh firmer (*japonicus* group).

f^1. Four or four and one-half rows of scales in a series from origin of second dorsal to, but excluding, the lateral line series.

g^1. Underside of head completely scaled.

h^1. Three to seven strong spinous carinae on scales of body; orbit, 1.0 to 1.3 in postorbital length of head; pectorals longer than postorbital portion of head; pyloric caeca about 20; color of peritoneum blackish ..... *smithi.*

h^2. Eight or nine weak spinous carinae on scales; orbit, 1.8 in postorbital length (as measured on Alcock's figure); pectorals shorter than postorbital portion of head; pyloric caeca about 40; color of peritoneum "silvery grey" ..... *flabellispinis.*

g^2. Underside of head scaleless.

i^1. Distance from center of anus to base of outer ventral ray equal to, or less than, length of orbit; a scaleless anterolateral groove on snout; nasal fossa naked; scales of median rostral ridge with carinae radiating in all directions from center of scale; median series of scales between occipital and postorbital ridges little enlarged; orbit, 1.2 to 1.7 in snout, 1.05 to 1.25 in postorbital length of head; spinous carinae on scales of body weak, 6 to 11 in number ..... *radcliffei.*

i^2. Distance from anus to base of outer ventral ray decidedly longer than length of orbit; anterolateral region of snout and lower half of nasal fossa scaled; scales of median rostral ridge with carinae diverging outward and backward from front of scale; median series of scales between occipital and postorbital ridges much enlarged;[1] spinous carinae on scales of body stronger, 3 to 9 in number.

j^1. Orbit almost as long as postorbital length of head.

k^1. Three to five spinous carinae on scales; snout longer, with outlines weakly convex; orbit, 1.8 in snout; barbel, 6 in orbit ..... *productus.*

[1] These characters derived from the squamation of the head have not been verified in *C. anatirostris*, but probably will not be found different in that species.

k^2. Six to nine spinous carinae on scales; snout "shaped like a duck's bill," its outlines strongly convex; orbit, 1.5 in snout; barbel, about 2 in orbit. *anatirostris.*

j^2. Orbit much smaller, 1.35 in postorbital length of head, 1.9 in snout; 5 to 7 spinous carinae on scales; compared with *C. productus*, the snout is longer and broader, and much more convex toward tip; barbel, 3.5 in orbit ..... *weberi.*

i^2. Five and one-half to seven rows of scales in a series from origin of second dorsal to, but excluding, the lateral line series; under side of head completely scaled; distance from center of anus to base of ventral longer than the orbit.

l^1. Sides of snout moderately convex; scales on top of head similar to those on body, with about 5 spinous carinae. *commutabilis.*

l^2. Sides of snout nearly straight; scales on top of head with usually but a single median keel, being thus very dissimilar to the scales of the body ..... *japonicus.*

b^2. Snout more than twice as long as orbit.

m^1. Tip of snout without a long spine; spinous carinae on scales of head radiating backward.

n^1. Underside of head naked, excepting a small oval patch below preopercular angle; body marked with cross bars both above and below lateral line ..... *tokiensis.*

n^2. Underside of head completely scaled.

o^1. Interdorsal space scarcely half as long as base of first dorsal; dark cross bars above, but not below, lateral line ..... *quadricristatus.*

o^2. Interdorsal space much longer than base of first dorsal; no dark markings ..... *macrorhynchus.*

m^2. Tip of snout with an excessively long spine; spinules on scales of head arranged mostly in quincunx order. *acutirostris.*[1]

C^2. Spinules on scales on a very strong median keel, with others in parallel rows; anus always immediately before anal fin; second dorsal spine shorter than postrostral length of head; body without definite dark markings; a natural group of species inhabiting the Atlantic, Indian, and western Pacific Oceans ..... OXYGADUS.

a^1. Under surface of head completely scaled.

b^1. Orbit larger, more than half length of snout, its length decidedly greater than the interorbital width; spinules on scales of head moderately rough, several in number on each scute along the ridges; sides of snout nearly straight.

c^1. Spinous ridges on scales, 3 to 5, usually 3; scales on top of head mostly with a single keel; interdorsal space about equal to base of first dorsal ..... *parallelus.*

c^2. Spinous ridges on scales, 5 to 7; scales on top of head with "stellate" ridges; interdorsal space figured as about twice length of first dorsal base ..... *kermadecus.*

[1] The systematic position of this species is questionable; an additional subgenus perhaps should be erected for it.

c^3. Spinous ridges on scales, 7 to 9, usually 9. *parallelus* (Brauer, *nec* Günther).[1]

b^2. Orbit smaller, about half length of snout, equal to interorbital width; spinules on scales of head excessively rough, 1 to 3 only on each scute along the ridges; sides of snout convex____*spinifer*.

a^2 Under surface of the head wholly devoid of scales.

d^1. Lateral spinules on scales about three-fourths as large as those on the median keel; first dorsal fin black at base, becoming silvery distally_____*aratrum*.

d^2. Lateral spinules on scales much smaller than those on the median keel; first dorsal fin uniformly colored.

e^1. Orbit smaller, 2.0 in snout, two-thirds postorbital length of head.

f^1. Spination of scales weaker, the lateral rows very weak, with many small spinules; total number of series, 3 to 13 on each scale_____*doryssus*.

f^2. Spination of scales much stronger than in *C. doryssus*, the lateral series especially with fewer and stronger spinules; total number of series, 3 to 5 on each scale_____*occa*.

e^2. Orbit larger, 1.5 to 1.8 in snout, about equal to postorbital length of head_____*talismani*.[2]

QUINCUNCIA, new subgenus.

Type-species.—Coelorhynchus argentatus Smith and Radcliffe.

This group includes, in addition to the type-species, two others described in this report—*C. quincunciatus* and *C. thompsoni*. These three species belong to the fauna of the Philippine Islands and the adjacent region to the southward; they are closely related to each other, and may be readily distinguished from all other members of the genus by the arrangement of the spinules on the scales in quincunx order (:·:) (not rising as serrulations along parallel or divergent carinae). The cardiform teeth of the upper jaw form a narrow band; the mandibular teeth are in two series, irregular anteriorly, in the type species, while in the two other species the two series become so irregular toward the symphysis that they form a narrow band. The anus is located far behind the head, immediately before the anal fin, and is not preceded by a naked fossa. The gland-like organ in the abdominal body wall is dilated at both ends —posteriorly just in advance of the anus, anteriorly in advance of the ventrals; this anterior lobe is supported, in the cavity that surrounds it, by a slender rod of cartilage connected with the posterior arm of the pubic bone.

The relationships of this natural group and of its species are indicated in the preceding analytical key. There now follows a detailed description of each form.

[1] The validity and position of this form are open to question.

[2] *Coelorhynchus vaillanti* Roule (1916) is a synonym of *C. talismani*.

21. COELORHYNCHUS ARGENTATUS Smith and Radcliffe.

Coelorhynchus argentatus Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, Sept. 27, 1912, p. 137, pl. 31, fig. 1.

Coelorhynchus acus Weber, Fische der *Siboga*-Expedition, May, 1913, p. 160.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° F.	
5279	China Sea, off southern Luzon	117		1
5291	....do	173	51.5	1
5516	Off northern Mindanao	175	54.3	3
5517	....do	169	54.3	1
5518	....do	200	54	1
5255	Gulf of Davao, Mindanao	100		1
5135	Vicinity of Jolo	161	57.4	5
[1]5172	....do	318		[1]2
5545	....do	114		3
5550	....do	200	54	1
5566	Between Jolo and Tawi Tawi	244	52.5	1

[1] The type specimen is one of the two from station 5172.

Inasmuch as both the description and figure given by Weber agree exactly with this species, it is evident that Weber's reference [1] of his *C. acus* to *C. commutabilis* Smith and Radcliffe, a wholly different species, can not be confirmed.

For the purpose of close comparison with the next two species, a detailed description has been prepared of *C. argentatus*. It is based upon the type-specimen, 143 mm. long to the anus, but is supplemented by measurements and counts of 13 other specimens ranging from 61 to 120 mm. long to anus.

Fin-rays—first dorsal, II, 9 (8 to 10); pectorals, 15–14 (14 to 20); ventrals, 7.

The dorsal contour is scarcely elevated at the origin of the first dorsal; before that point the outline is evenly convex; the ventral contour is gently curved. The body varies from robust to slender, the greatest depth being contained 1.68 (1.7 to 2.4) times in the head; the greatest width of the body, across the pectoral bases, 2.55 (2.4 to 3.0) times.

The tip of the snout is comparatively rather blunt. The dorsal margin of the snout is nearly straight; the lateral margins are slightly concave immediately behind the tip, but thence nearly straight to the more or less prominent anterolateral angles. The tip of the snout is on a horizontal passing slightly below (sometimes through) the lower orbital margin. Preocular length of snout in head, 2.8 (2.4 to 2.7); preoral length, 3.8 (2.9 to 3.6); width of snout opposite front of orbits, 3.66 (3.3 to 3.7); width at anterolateral angles, 1.0 (to 1.3) in the distance anterior to that point. The occipital ridges converge from both ends toward their middle,

[1] Fische der *Siboga*-Expedition, May, 1913, p. 671.

where the least distance between them is contained 3.1 (2.6 to 3.4) times in the interorbital width; posteriorly the ridges grade "into a shallow, scaleless groove which is continuous with the lateral line"—a condition indicated in Weber's figure of his *C. acus*. The postorbital ridge is curved slightly downward behind the ridge of the preopercle. The infraorbital ridge is less prominent than in any other species examined, with the single exception of *C.* (*Abyssicola*) *macrochir*. The lower angle of the subopercle is obtusely angulated, but without the prominent sharp flap diagnostic of the subgenera *Paramacrurus*, *Oxymacrurus*, and *Oxygadus*. The length of the orbit is contained 4.2 (3.7 to 4.25) times in the head, 1.4 (1.4 to 1.75) times in the snout, 1.7 (1.3 to 1.6) times in the postorbital. The interorbital width, least above the front of the pupil, is about equal to the orbital length, being contained 1.7 (1.4 to 1.6) times in the postorbital. The maxillary extends from below the middle of the large nasal fossa backward to beyond the vertical from the hind margin of the orbit; the length of the upper jaw is contained 2.8 times in the head in the type, from 2.9 to 3.3 times in the smaller specimens. Length of the slender barbel, 3.75 (2.6 to 4.2) in postorbital.

The premaxillary teeth are cardiform and are disposed in a narrow band. The mandibular teeth are in two series, which become a little irregular in large specimens; the inner of the two series is enlarged.

The sensory canal system of the head is well developed. Between the occipital and the postorbital ridges there is a spacious cavity, on the bottom of which large sense organs are located. Each of these organs lies on a scale-like neuromastic bone, the two ends of which rise upward and outward as slender curved rods, arching toward each other, and supporting the skin which forms the roof of the sensory cavity. Where the cavity becomes shallow posteriorly, behind the ridge of the pectoral girdle, its floor is covered by two scales or scale-like bones similar to those described by us in *Bathygadus* and *Hymenocephalus*.[1] Their similarity to the structure just described is greatly increased by the presence in each of slender rods passing outward to the skin. These two scales or scale-like bones are of irregular outline, being convex behind; the anterior of the two is imbricate over the second, which in turn is imbricate over the normal scales. The skin lying over these plates is covered with small scales, which are separated by a narrow scaleless groove from the adjacent scales of the body, over which the posterior plate just described is imbricate. The cavity in which these neuromastic bones lie is connected by a foramen with the cavity immediately behind the orbit, and with the

[1] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 149, 186.

superior rostral sensory canal by means of a foramen, which is roofed over by a bony arch forming the anterior part of the occipital ridge. From the upper edge of the high median rostral crest of each side there branches off a slender horizontal rod, which supports the skin over a large sense organ.

The position of the anus is more posterior than in other species; its distance from the base of the ventral fin, 1.95 (1.8 to 2.3) in head; its distance from the isthmus, 1.16 (1.15 to 1.32). The distance between the base of the outer ventral ray and the isthmus is contained 2.7 (to 3.0) times in the head.

A highly differentiated organ, of problematic function, lies in the body wall on the midabdominal line. It is probably homologous to, but more complicated than, similar structures which we have described in *Coelorhynchus* and in other genera. As we have found this organ with skeletal support only in this subgenus (*Quincuncia*), its structure is probably diagnostic of the group. A description of this organ follows. A black superficial streak extends forward from the anus, at each end dilated into an area in which the scales are much reduced in size. The distance between the anterior end of this black streak and the isthmus is a little greater than half the orbital length. Immediately above this streak, between the ventral ends of the lateral muscles, there is located the organ being described. It consists of a stand of soft tissue, more or less pigmented on its ventral (or outer) surface, firmly united with the peritoneum, and expanded at each end into a depressed dilation. The posterior one is bilobed, being divided by the anus. The thick anterior dilation is roughly triangular in outline, with a convex anterior edge. It lies within a cavity, and is supported in a strikingly peculiar manner by a cartilaginous rod in close connection with the pelvic girdle. The posterior arm of this bone is a poorly ossified plate, which by meeting its fellow at the median line, forms a brace directly between the ventral bases. From the anteromedian angle of each of these posterior limbs a cylindrical rod of cartilaginous tissue extends forward to the sides of the anterior dilation, from which it extends dorsad, meeting its fellow in a wide arch, the apex of which is bound to the well ossified anterior arms of the public bone, where these meet at the median line.

Nine pyloric caeca, much shorter than the orbit, were counted in one specimen.

Shrimp-like crustaceans were found in the stomachs of two specimens.

The lateral line gently rises anteriorly to form a long, low curve, the chord of which is about as long as the distance between the anus and the isthmus. The thin scales are armed with short, stout, suberect spinules, which are arranged in quincunx order (occasionally showing a tendency to align themselves to form parallel or divergent

series). There are five or six rows of scales between the origin of the second dorsal fin and the lateral line series.

The scales on the head are in general quite similar to those of the body, but the spinules on them are stronger and more nearly erect. The spinules along the weak ridges of the head are often arranged in strongly divergent series, and are comparatively little strengthened. The dorsoterminal rostral plate is poorly developed, being scarcely produced in the larger specimens. The scales along the infraorbital ridge are flat; only along the ventral margins of these scales are the spinules strengthened; these ridge scales are in a single series before the middle of the eye, but are in two series posteriorly. The median rostral ridge is covered by quadrate scales in a series continued backward almost to the median occipital scute; this median series is flanked on each side by a single series of scales. The occipital scute is preceded by a partly scaled area, and is immediately followed by a similarly strengthened scale. The large and irregular scales between the occipital and the postorbital ridges cover the sensory canal already described; this area is well defined, and is continued backward to below the origin of the first dorsal fin, being confined to the region below the scaleless groove continuous with the lateral line (the scales in the posterior portion of the area are of decreased size). Only a few weakly spinous or smooth scales are present on the lower part of the nasal fossa, and between the orbit and the infraorbital ridge; the anterolateral region of the snout is largely naked; the underside of the head is wholly scaleless, including the branchiostegal membranes, but excluding a well-defined and highly diagnostic crescent-shaped area just below and within the anterolateral margins of the snout.

The base of the first dorsal fin is contained 1.4 (to 1.05) times in the interval between the two dorsals, and 2.0 (to 1.6) times in the postorbital length of the head. The anterior rays of the second dorsal fin are very short. The origin of the anal fin is behind that of the second dorsal, and also (with few exceptions) behind the end of the pectoral. The ventral fin never reaches the anus except in very young individuals. Length of the fin rays in the head (in specimens exclusive of the type)—second dorsal spine, 1.95 to 2.5; pectoral fin, 2.2 to 2.9; outer ventral ray, 2.6 to 3.3; inner ventral rays, 3.3 to 4.2.

Coloration in alcohol.—The body, especially in the young, is marked by dark mottling on the trunk and by numerous dark vertical bars on the tail. The ventral portion of the branchiostegal membrane is jet black; the gular membrane is crossed by numerous fine black lines on minute ridges, between which the silvery ground color is prominent. This type of coloration is not to be confused with the true striations of *Hymenocephalus*, for in that genus

both types are sometimes found together on the gular membrane (see descriptions of the species of *Hymenocephalus*). The surface over the pectoral girdle, where covered by the gill covers, is largely silvery, but is dark in front of the pectoral fin. The lining of the buccal cavity, in strong contrast to its color in most species, is whitish; the lining of the branchial cavity is whitish over the hyoid arch, but brown elsewhere, shading to black just within the abrupt and narrow white margin along the branchiostegal and opercular membranes. The parietal peritoneum is for the most part dark purplish brown, underlain with silvery, but is whitish along each side of the ridge formed by the organ already described. The opercles show silvery and bronzy reflections. The region of the occiput is blackish. The eye-ball is blackish dorsally, silvery ventrally; the pupil is surrounded by a very narrow silvery ring; the iris is more or less yellowish, but without a well-defined yellow ring as in *C.* (*Abyssicola*) *macrochir*. The bases of the first dorsal and the paired fins are blackish, as are also the tips of the ventral rays.

In the larger specimens the striking silvery color of the sides is bounded above by a dark streak along the tail.

In a young specimen, measuring only 24 mm. to the anus, the abdomen is whitish, excepting the dark streak along the mid-ventral line; the branchiostegal membranes are light, with dark specks; the gular membrane is light brown, without the dark transverse streaks (these are already apparent in a specimen 32 mm. long to the anus); and the fins lack their blackish bases. Small specimens differ also in their proportions from larger ones, as the following table shows.

Table of measurements in hundredths of length to anus.

	Type.				
Albatross station	5172	5172	5118	5135	5545
Total length in mm	365	[1] 281	334	.....	.....
Length to anus in mm	143	120	92	66.6	24
Length of head	65.5	65	67.5	67	71
Length of orbit	16.3	16	17	17.3	22
Length of postorbital	27	25.3	24.5	23	24
Width of interorbital	15.8	16.5	17	16	20
Width of suborbital	7.5	7.5	8	7.3	9
Orbit to preopercle	26.7	27.3	27	28	27
Length of snout	23.5	25	27.2	27.2	27.5
Length of maxillary	24	21.6	21	20.6	22
Depth of body	39.5	35	37	32	33
Width of body	26	24.4	26	23.3	23
Anus to ventral	34	33	34	34	32
Ventral to isthmus	24	24	23.3	23	24
Length of first dorsal base	13.3	14	13.3	13	14
Length of interdorsal space	28.4	38	18	18.6	17
Length of pectoral fin	.....	.....	26	26	29
Length of outer ventral ray	.....	23.5	22	26	.....
Length of second ventral ray	.....	17.6	17	18	.....

[1] A pseudocaudal developed.

(*argentatus*, in reference to the silvery coloration.)

22. COELORHYNCHUS QUINCUNCIATUS, new species.

Type-specimen.—Cat. No. 78213, U.S.N.M., a mature female 237 mm. long to end of a pseudocaudal of 7 rays, or 93.3 mm. to anus; from *Albatross* station 5392, between Samar and Masbate, in 135 fathoms.

List of paratypes.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° F.	
5121	Off east coast of Mindoro	108		2
5392	Between Samar and Masbate	135		6
5396	do	137		1
5397	do	134		2
5412	Between Cebu and Bohol	162	54.8	1
5454	Off southeastern Luzon	153		1 yg.

This species is not recorded at depths so great as are *C. argentatus* (318 fathoms) and *C. thompsoni* (200 fathoms).

In the description which follows, those measurements and counts included in the parentheses after each measurement or count of the type, were taken on paratypes 60 to 77 mm. long to anus. When markedly different, there are added, separately, the measurements of three smaller specimens, 50 to 57 mm. long to anus.

Fin-rays—first dorsal, II, 9 (or II, 10); pectorals, 16 (to 18); ventrals, 7.

The greatest depth of the body is contained 2.1 (1.85 to 2.3) times in the head; the greatest width, across the pectoral bases, 3.0 (2.5 to 3.3) times. The dorsal contour is slightly concave on the snout and weakly convex between the snout and the first dorsal. The snout closely resembles that of *C. argentatus;* it has a slightly acuminate tip, which is on a horizontal passing below (or through) the lower margin of the pupil. The proportions of the snout follow: preocular length, 2.4 (2.3 to 2.55) in head; preoral length, 3.15 (2.8 to 3.3); width of snout at front of orbits, 3.5 (3.33 to 3.5); width across snout at anterolateral angles, 1.2 (1.1 to 1.3) in the distance anterior to the angle. The occipital ridges diverge strongly toward both ends; the least distance between them is contained 3.0 (2.9 to 3.3) times in the interorbital; the ridge is followed by a naked groove which bounds above that area of scales which covers the large sensory canal anterior to the origin of the lateral line. The postorbital ridge curves slightly downward behind the preopercular angle. Length of the orbit in the type-specimen (93.3 mm. to anus), 4.65 in head, 1.9 in snout, 1.7 in postorbital; orbit in specimens 60 to 77 mm. to anus, 4.0 to 4.15 in head, 1.65 to 1.75 in snout, 1.35 to 1.5 in postorbital; orbit in paratypes from 50 to 57 mm. to anus, 3.9 in head, 1.6 in snout, 1.3 in postorbital. The least interorbital width (anterior to

the front of the pupil) is about equal to the orbital diameter, being contained 1.6 (1.3 to 1.5) times in the postorbital. The least suborbital width is contained 3.1 times in the postorbital (2.9 to 3.2 times in paratypes from 60 to 77 mm. to anus; 2.7 to 2.85 times in paratypes from 50 to 57 mm. to anus). The upper jaw extends from below the middle of the nasal fossa backward nearly to the vertical from the posterior margin of the orbit; length of upper jaw, 3.3 (3.4 to 3.7) in head. The barbel is slender; its free length is contained 2.6 (2.3 to 3.3) times in the postorbital.

The cardiform teeth of the upper jaw form a band, the outer series of which is sometimes enlarged. The mandibular teeth form two series laterally, of which the outer series is irregular; anteriorly, near the symphysis, the teeth are so irregularly arranged as to form a narrow band.

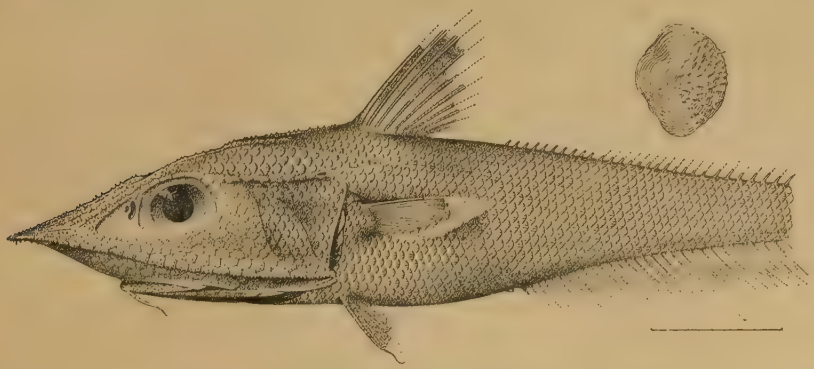

FIG. 7.—COELORHYNCHUS QUINCUNCIATUS. TYPE.

The characters of the sensory canals and of the structures connected with them, are essentially similar to those described for *C. argentatus*.

The anus is located immediately before the anal fin; the distance from its center to the base of the outer ventral ray is contained 2.4 (2.5 to 3.2) times in the head; its distance from the isthmus, 1.32 (1.4 to 1.6) times. The distance between the base of the ventral and the isthmus is contained 2.8 (2.85 to 3.27) times in the head.

The gland-like body lying in the body wall, along the midventral line, has the peculiar structure that it also possesses in the last species—the anterior dilation is supported by a slender rod connected with the pubic bone.

Pyloric caeca, 8 to 11 (4 specimens).

Several specimens contained crustacea of various groups in their stomachs, but one contained a Myctophid fish, probably *Myctophum*, belonging to the silvery pigmented or surface-pelagic type.

The lateral line rises anteriorly to form a long, even curve. The scales are relatively large, in but four rows between the lateral line

series and the front of the second dorsal. The scales are rather thin, and are thickly beset with short slender spinules, which are directed outward and backward, and are arranged in definite quincunx order, except on and near the head, where they fall into very widely divergent rows. The scales of the head bear weak spinules, which are smaller than those of *C. argentatus;* those on the ridges of the head are little strengthened. Instead of being followed by a single median scute, as in *C. argentatus*, the occipital scute is preceded on each side by a similar scale. The squamation of the head is more complete than in *C. argentatus:* the anterolateral region of the snout is largely scaled, leaving only a narrow scaleless groove adjoining the series of scales which bounds the median rostral series on each side; the under surface of the head is wholly scaled, including the rami of the mandibles, and excluding only the lips and the gular and branchiostegal membranes. In other respects the squamation of the head is the same as in *C. argentatus.*

The length of the first dorsal base is contained 1.2 (0.75 to 1.3) times in the interdorsal space, 1.8 (1.5 to 1.9) times in the postorbital. The anterior rays of the second dorsal fin are very short. The origin of the anal is slightly behind (or slightly before) the vertical from the origin of the second dorsal. Length of fin-rays in the head (in paratypes): second dorsal spine, 2.1; pectoral fin, 2.4 to 2.65; outer ventral ray, 3.0 (3.2 in type), sometimes reaching anus; inner ventral rays, 3.75 to 4.2.

Coloration in alcohol.—The dark markings of the body consist anteriorly of weakly ocellated dorsal saddles, and posteriorly of dark bars; a dark blotch is located on the lateral line below the first dorsal. The sides of the body and head are silvery, but there is a dark blotch on the opercles. The gular membrane is punctulate, with but traces of the cross striae or black ridges characteristic of this region in *C. argentatus;* the branchiostegal membrane is black ventrally, and blackish or dusky laterally. The skin over the pectoral girdle is mostly silvery, but becomes abruptly dark brown over the anterior face of the girdle before the pectoral fin. The buccal cavity is lined with whitish; the walls of the branchial cavity are dusky (except over the hyoid arches, where they are whitish), becoming blackish posteriorly, but with an abrupt whitish margin along the edge of the opercular and branchiostegal membranes. The parietal peritoneum is brownish black, underlain with silvery; it is sometimes whitish over the posterior portion of that organ which lies in the body wall before the anus. This organ is superficially covered by a black streak, with an anterior dilation between the ventral fins and the isthmus and a posterior dilation in front of the anus. From each side of these dilations a diffused darker area

spreads out. The region immediately around the base of the first dorsal, the axillary region of the pectoral, and the dorsal spine, are all black; the ventrals are sometimes blackish near their bases, and near the tips of their rays; elsewhere the fins are light dusky.

C. quincunciatus differs quite widely from *C. argentatus*, although the two species obviously belong to the same group. The scales are larger in *quincunciatus*, being in but four, instead of five or six, rows between the lateral line series and the origin of the second dorsal fin; the underside of the head is completely scaled, instead of being wholly scaleless, except for a definite small anterolateral patch; the anterolateral region of the snout above is almost wholly scaled, instead of being mostly naked; the spinules on the scales of the head are weaker; the gular membrane is punctate, rather than transversely striate; the anus is located farther forward, its distance from the ventral fin being contained 2.4 to 3.2 times in the head (rather than from 1.8 to 2.3 times); its distance from the isthmus is contained from 1.32 to 1.6 times in the head (rather than from 1.15 to 1.32 times); the barbel is usually longer, being contained from 2.3 to 3.0, instead of from 2.6 to 4.2 times in the postorbital; the snout is usually longer, its preoral length being contained 2.3 to 2.55 times in the length of the head, instead of from 2.4 to 2.8 times. *C. quincunciatus* appears to be intermediate in its relationships between the preceding species, *C. argentatus*, and the one next to be described, *C. thompsoni*. An analysis of the three species is given in the key, and another after the description of *C. thompsoni*. Of the three forms, *C. argentatus* apparently attains the largest size.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.				
Albatross station	5392	5121	5121	5396	5412	5497
Total length in mm	[1] 237	225	194	[1] 182	[1] 188	147
Length to anus in mm	93.3	77	68	72	70.5	50
Length of head	71	71	68	72	73	76.5
Length of orbit	16	17	18	19	18	21
Postorbital length of head	26.5	24	24	26	26.5	26
Width of interorbital	16.5	18	18.5	18	17.5	20
Width of suborbital	8	9	8	8	9.5	9.5
Orbit to preopercle	28	27	26	28	28	29
Length of snout	30	30.5	31	29	31	32
Length of upper jaw	21.5	22	20.5	21	20	21.5
Depth of body	34	37	38	35	34	37
Width of body	24	27	29	.....	23	20
Anus to ventral	30	28	28	24	26	26
Ventral to isthmus	25	26	23	26	25	26
Length of first dorsal base	15	14	14	13.5	13.5	15
Length of interdorsal space	18	15	16	15	18	12.5
Length of second dorsal spine	.....	.....	.....	34	.....	33
Length of pectoral fin	.....	27	.....	.....	28	31
Length of outer ventral ray	23	.....	.....	.....	.....	.....

[1] A pseudocaudal developed.

(*quincunciatus*, in reference to the quincunx arrangement of the spinules on the scales.)

23. COELORHYNCHUS THOMPSONI, new species.

Type-specimen.—Cat. No. 78214, U.S.N.M., a mature female 106 mm. long to anus, dredged at *Albatross* station 5363, at a depth of 180 fathoms, in Balayan Bay, on the southwest coast of Luzon.

Four other specimens were obtained:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5110	China Sea, off southern Luzon	135	59.0	1
5118	Verde Island Passage, Luzon	159	.....	1
5518	Off northern Mindanao	200	54.0	2

The two specimens from station 5518 show certain differences from the typical specimens, and are referred with some doubt to the same species. It is of interest to note in this connection that all of the 14 specimens of the preceding species, *C. quincunciatus*, were dredged at six stations among the islands between the localities at which typical and aberrant specimens of *C. thompsoni* were obtained. The aberrant specimens differ in the rougher spination of the scales, in the fewer pyloric caeca (14 instead of 22), and in the slightly narrower interorbital and suborbital.

Fin-rays—first dorsal, II, 9; pectorals, 15–16 (17 or 18); ventrals, 7.

Greatest depth of body, 2.2 (2.3 to 2.4) in head; width across pectoral bases, 3.3 (3.3 to 3.7). The sides of the snout gradually converge forward toward the very sharply acuminate tip, which, higher than in *C. argentatus* or *C. quincunciatus*, lies on a horizontal passing through the eye above the lower margin of the pupil. The greater convexity of the dorsal outline of the snout, together with other characters, renders the physiognomy of this species very different from that of *C. argentatus* and *C. quincunciatus*, which are quite similar in their general appearance. The preocular length of the snout is contained 2.2 (2.1 to 2.15) times in the head; preoral length, 2.35 (2.23 to 2.3); width of snout at front of orbits, 3.5 (3.3 to 3.6); width of snout at anterolateral angles (a point below the front of the nasal fossa), 1.5 (1.4 to 1.55) in the distance anterior to that point (in other words, in the ethmoid region of the infraorbital ridge). The occipital ridges diverge strongly anteriorly, but weakly posteriorly; the least distance between them is contained 2.4 (2.5 to 2.65) times in the interorbital width; from their terminations on each side a scaleless groove extends backward to the lateral line. The sharp postorbital ridge curves slightly downward behind the preopercular ridge; the subopercular angle

is obtusely pointed. The orbit is conspicuously larger than in *C. argentatus* or *C. quincunciatus;* its length is contained 3.9 (3.85 to 4.15) times in the head, 1.8 (1.8 to 1.95) times in the snout, 1.15 (1.05 to 1.2) times in the postorbital. The least interorbital width is greater than in the other species of the subgenus, it is a little less than the orbital length, and is contained 1.3 (1.23 to 1.4) times in the postorbital. The suborbital also averages wider, being contained 2.6 (2.5 to 3.0) times in the postorbital. The short upper jaw extends backward from below the posterior nostril not so far as the vertical from hind margin of the orbit; its length is contained 4.05 (4.2 to 4.35) times in the head. The barbel is short, being contained 4.4 (3.4 to 4.6) times in the postorbital. The cardiform teeth of the premaxillary are in a narrow band; those of the lower

FIG. 8.—COELORHYNCHUS THOMPSONI. TYPE.

jaw, in two irregular series on the sides posteriorly, become so crowded near the symphysis as to form a narrow band.

The anus is located immediately in advance of the origin of the anal fin, somewhat farther forward than in *C. quincunciatus*, and much farther forward than in *argentatus;* it lies below the posterior half of the interdorsal space; the distance from the center of the anus to the base of the outer ventral ray is contained 2.7 (2.9 to 3.5) times in the head; the distance between the ventral fin and the isthmus (at the front of the scaled area), is contained 3.3 (3.6 to 3.85) times in the head; the total distance, from the anus to the isthmus, 1.6 (1.65 to 2.0) times. As in *argentatus* and *quincunciatus*, the anterior lobe of the gland-like body in the abdominal wall is supported by a slender rod connected with the joined ends of the two pairs of arms of the pubic bones.

Pyloric caeca—14 in 2 specimens (stations 5110 and 5118); 22 in 2 specimens (station 5518); 9 were counted in a specimen of *argentatus*, and 8 to 11 were counted in 4 specimens of *quincunciatus*.

One of the specimens from station 5518 contained in its stomach one of the horny jaws (1 cm. long) of some cephalopod.

The lateral line courses along a low curve anteriorly. The large scales are in but four series between the lateral line and the origin of the second dorsal fin; they are covered with small suberect spinules, arranged in quincunx over most of the body, but aligned, more or less definitely, into strongly divergent series anteriorly, especially on the head. The scale characters of the species agree with those of *quincunciatus* in contrast with those of *argentatus;* the median occipital scute is preceded by a similar scale on each side; a narrow scaleless groove extends backward along the upper surface of the snout just outside the series of scales bounding the median rostral series. The under surface of the head is completely scaled, with the exception of the gular and branchiostegal membranes, and of the rami of the mandibles, which have only a few scales posteriorly (the rami are completely scaled in *C. quincunciatus*).

Fin measurements of specimens from southern Luzon—length of first dorsal base 1.2 (1.0 to 1.35) in the interval between the dorsal fins, 1.8 (1.65 to 1.9) in the length of the head behind the orbit; length of pectoral fin, 3.05 and 3.3 in the head (two specimens); outer ventral rays, 4.3 (one specimen); second ventral ray, 5.1 (one).

Fin measurements of specimens from station 5518—first dorsal base, 0.9 and 1.2 interdorsal, 1.65 and 2.0 in postorbital; outer ventral ray, 3.6 (one specimen); second ventral ray, 4.65 (one).

The origin of the anal fin is slightly before (or directly below) that of the second dorsal.

The dark markings of the young become indistinct in the adult. In the specimen 150 mm. long there are several dark dorsal saddles anteriorly—one just before the first dorsal fin, another below that fin, a third below the posterior part of the interdorsal space and the anterior end of the second dorsal fin, and two posterior to these; of these saddles the penultimate and the one under the first dorsal extend a short distance below the lateral line. Posteriorly the tail is crossed by dark vertical bars about as wide as the interspaces between them. The occipital region is dusky. The silvery area covers the sides of the head, the trunk below the lateral line, and the median third of the sides of the tail. The belly is dusky between the ventral fins and the isthmus and about the anus, from which region a black streak extends forward to an anterior elliptical dilation covering the gland-like organ in the body wall. The axil of the pectoral is black. The snout is dark along its margins and mid-dorsal line, and dusky below. The concealed region about the tip of the premaxillaries is dark; the inner wall of the sensory cavity just above the ventral

margin of the suborbital region, is dark, showing through the thin outer wall of the cavity; the rami of the mandibles are dark. The gular membrane has a ground color of silvery white, especially on the sides where covered by the mandibular rami, but is darkened by punctulations or a diffused dark expansion of the chromatophores. The branchiostegal membranes are dusky ventrally, but, together with the opercular membranes, are margined with light on their sides, just behind the submarginal blackish area of the branchial cavity, which shows through the opercles to the exterior; the roof of the branchial cavity is dark; the walls of the buccal cavity are light; the parietal peritoneum is blackish, underlain with silvery. The vertical fins and the pectoral are dusky; the dorsal spine is blackish; the ventral fin rays are light, with dusky tips and dusky bases in some specimens.

C. thompsoni differs from *C. argentatus* in much the same manner that *C. quincunciatus* does; the scales are larger, being in but four series, instead of five or six, between the lateral line and the origin of the second dorsal fin; the underside of the head,[1] and the antero-lateral region of the snout above, are scaled, instead of being mostly naked; and the gular membrane is punctate, rather than transversely striate. From both of the other species *C. thompsoni* differs in the more posterior position of the front of the premaxillaries, which lie below the posterior nostril, instead of below the middle of the large nasal fossa. Further differences between *C. thompsoni* and *C. quincunciatus* consist chiefly in the various proportions. These differences are tabulated in the following comparison; further differences between *thompsoni* and *argentatus* are also indicated.

Comparative table showing the differences in certain proportions between the species of the subgenus Quincuncia.

	C. argentatus.	*C. quincunciatus.*	*C. thompsoni.*
Anus to base of ventral in head	1.8 to 2.3	2.4 to 3.2	2.7 to 3.5
Anus to isthmus in head	1.15 to 1.32	1.32 to 1.6	1.6 to 2.0
Preocular length of snout in head	2.4 to 2.8	2.3 to 2.55	2.1 to 2.2
Preoral length of snout in head	2.9 to 3.8	2.8 to 3.3	2.22 to 2.35
Width of snout at anterolateral angles in distance anterior thereto	1.0 to 1.3	1.1 to 1.3	1.4 to 1.55
Orbit in snout	1.4 to 1.75	1.6 to 1.9	1.8 to 1.95
Orbit in postorbital	1.3 to 1.7	1.3 to 1.7	1.05 to 1.2
Interorbital in postorbital	1.4 to 1.7	1.3 to 1.5	1.23 to 1.4
Suborbital in postorbital	2.9 to 3.4	2.7 to 3.1	2.5 to 3.0
Distance between occipital ridges in interorbital	2.6 to 3.4	2.9 to 3.3	2.4 to 2.65
Maxillary in head	2.8 to 3.3	3.3 to 3.7	4.05 to 4.35
Pectoral fin in head	2.2 to 2.9	2.4 to 2.65	3.05 to 3.3
Outer ventral ray	2.6 to 3.3	3.0 to 3.2	3.6 to 4.3
Second ventral ray	3.3 to 4.2	3.75 to 4.2	4.65 to 5.1
Barbel in postorbital	2.6 to 4.2	2.3 to 3.0	3.4 to 4.6

[1] With the exception of the mandibular rami, which are nearly naked in *thompsoni*, but scaled in *quincunciatus*.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.	
Albatross station	5363	5118	5110
Total length in mm	206+	[1] 176	150
Length to anus in mm	106	77	57
Length of head	72	75	80
Length of orbit	19	18.5	20.5
Postorbital length of head	21.5	22	21.5
Width of interorbital	16	18	18
Width of suborbital	8	8	9
Orbit to preopercle	25	26	26
Length of snout	33.3	36.5	38
Length of upper jaw	18.5	17.6	18
Depth of body	33	32	32
Width of body	22	23	22
Anus to ventral fin	26.5	26.5	21.5
Ventral to isthmus	22.5	21	19
Length of first dorsal base	11.5	11.3	13
Length of interdorsal space	14.7	15	12.5
Length of pectoral	.....	25	.....
Length of outer ventral ray	.....	.....	19
Length of second ventral ray	.....	16	.....

[1] A pseudocaudal developed.

(*thompsoni*, named for Mr. Will F. Thompson, in recognition of his ichthyological investigations.)

Subgenus PARAMACRURUS Bleeker.

The richness[1] of the fauna of the East Indian and Phillipine Islands in the species of this subgenus has already been mentioned. Most of these species are closely related to the two which have already been described; namely, *C. notatus* and *C. argus*.

24. COELORHYNCHUS MACULATUS, new species.

Type-specimen.—Cat. No. 78215, U.S.N.M.: 191 mm. total in length to broken tip of tail, 66 mm. to anus; a female, with ripe ova; type locality, *Albatross* station 5621, between Gillolo and Makyan Islands.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Number of specimens.
[1] 5290	China Sea, off southern Luzon	214	[1] 1
5366	Batangas Bay, off Southern Luzon	240	1
5621	Between Gillolo and Makyan Islands	298	6
5623	Between Gillolo and Makyan Islands (latitude 0° 16′ 30″ N.)	272	4

[1] Specimen being in poor condition, not designated as a paratype.

These 12 specimens represent a small species which markedly differs from the others of the same group in the extreme roughness of the scales, both on the head and body.

Fin-rays—first dorsal, II, 9; pectorals, 16 (15 to 17); ventrals, 7 (6 on one side in one paratype).

[1] Nine of the 16 known species belong solely to this region.

The slender body is not strongly compressed, the width being equal to the depth below the origin of the lateral line; the greatest depth is contained 1.8 (to 1.95) times in the head. The dorsal contour of the snout in this species is straight, and is more oblique than the postrostral outline, which is nearly straight; the ventral contour is gently convex behind the mouth. The snout is broad and deep, with sides evenly and strongly convex to the bluntish tip, which is not produced in the type, and but little produced in the

FIG. 9.—COELORHYNCHUS MACULATUS. TYPE.

smaller paratypes; the extreme tip of the snout, through the terminal plates, is not depressed. The dimensions of the snout follow.

Table of measurements of the snout at different sizes.

	Type.	Paratypes.						
Length of head, in mm	46.5	41	40	39	38	37.5	36.5	35.5
Proportions in head:								
Preocular length	2.7	2.65	2.4	2.6	2.4	2.6	2.4	2.3
Preoral length	3.1	3.00	2.9	2.9	2.75	3.0	2.7	2.45
Width, at front of orbits	3.3	3.35	2.6	2.55	2.45	.....	2.4	2.6

This table seems to indicate that the relative length of the snout decreases with increased size, as it does also in *C. jordani* and in other species of this subgenus, while the reverse condition obtains in certain species of the subgenera *Oxymacrurus* and *Oxygadus*.[1] The middle of the length of the head in the largest specimen, the type, is at the center of the pupil, while it is at the front margin of the pupil in the smallest specimen, in which the head is 35.5 mm. long. The scaly ridges of the head are strongly developed, the occipital

[1] We find the same condition, however, true in *C. aratrum*, an Hawaiian species of the subgenus *Oxygadus*.

ridges in particular forming a crest unusually high for a species of the subgenus *Paramacrurus*. The posteroventral angle of the subopercle is produced backward and slightly downward into a pointed flap. The length of the rounded-oblong orbit is contained 3.25 times in the head, 1.2 in the snout, 1.15 in the postorbital length of the head (measurements of orbit in smallest paratype: 3.4 in head, 1.35 in snout, 1.0 in postorbital). The least interorbital width, which is contained 1.5 (1.3 to 1.6) times in the postorbital, lies above the front of the pupil; behind this point the slightly convex sides of the interorbital diverge strongly; least interorbital width, 2.2 (to 2.25) in postorbital. The mouth is rather small, the length of the upper jaw, which extends backward to below the hind margin of the pupil, is contained 4.0 times in the head (3.9 to 4.3 times in the paratypes). The outer series of the villiform teeth forming the premaxillary band is scarcely enlarged. Length of the free portion of the barbel, 6 (3.5 to 5.5) in postorbital. Branchiostegal rays, six; the gill-membranes are attached to the isthmus, leaving a narrow free fold.

The distance from the center of the anus to the base of the outer ventral ray varies from about two-fifths (in the type) to one-fourth the distance from the anus to the base of the outer ventral ray, the latter distance is slightly shorter, or slightly longer than, the postorbital length of the head, and is usually, but not constantly, a little longer than the distance from the ventral to the isthmus.

A well-marked, narrow, scaleless ventral fossa, widest anteriorly, extends forward from the peritroct to between the ventral fins. An ovoid gland-like body lies imbedded in the body wall above the front part of this fossa, and is connected by a strand of tissue with the peritroct; it is without apparent skeletal support. The "gland" is pigmented with black on its ventral and posterodorsal surfaces, while the posterior stand of tissue is pigmented on its lower side only. We have described similar structures in other groups of *Coelorhynchus*, as well as in species of *Hymenocephalus* and *Lionurus*.

The pyloric caeca are rather short and slender, 28 to 32 in number (counted in four paratypes).

Scales in 6 or 5½ series from the origin of the second dorsal fin to, but excluding, the lateral line scale. There are at most 5, and often fewer, spinous carinae on the scales, but they are much stronger and somewhat more divergent than in related species. The median ridge on the scales of the body bears as many as 9, but usually fewer, strong retrorse spinules, imbricate on one another, and increasing in size posteriorly; the last one projects well beyond

the margin of the scale. The scales become reduced in size and armature on the belly, especially toward the isthmus. The scales of the body appear to be more deciduous than in related species, but their more frequent loss may be in part due to their greater roughness.

The nasal fossa and the under surface of the head are wholly scaleless; elsewhere on the head the scales are strong, and bear spinules which differ from those of the related Philippine species in their greater strength, and differ from those of *C. kishinouyei* of Japan in the fact that they are not arranged in series radiating from the center of the scale. The dorsoterminal plate of the snout is not especially strengthened, and does not project beyond the anterolateral margin of the snout; the length of the plate is contained 5 to 6 (3.3 in smallest specimen) times in the postorbital; it is armed by one median and two marginal pairs of series of spinules (subject to some variation); the spinules of the plate, as on the other ridge scales, are less numerous and less regularly arranged in small specimens. The terminal plate is followed on each side of the snout by a series of eight or nine scales, increasing in size posteriorly, and covering the bony ridge formed by the ethmoid; the spinules on these scales form irregularly radiating series; a short interspace then separates the ethmoid series from the following preorbital series, which consists of 10 (to 7) subquadrate scales, small in front, but decidedly larger below the posterior nostril; the spinules form series radiating upward and backward from the anteroventral angle of each scale in the preorbital series; the two following portions of the infraorbital ridge—namely, the suborbital and the preopercular, are covered by a double row of scales, strongest below the posterior third of the orbit. The median superior rostral ridge bears 10 oblong scales, all of which, except the small last one, are of subequal size; the spinous carinae on these scales diverge outward and backward from the front margin of each scale. The supranarial ridge is arched upward and inward; it is armed by small scales, which become larger posteriorly, where the supranarial ridge meets two others: one, the supraorbital, extending backward; the other, the antorbital ridge, which bears a series of three strong scales, extending along the front margin of the orbit and the hind margin of the nasal fossa downward to opposite the middle of the posterior nostril.

The supraorbital series of scales forms the margin of the interorbital area; in small specimens all of the narrow scales of this series are rough with spinules, while in the larger specimens most of them, except at the two extremes of the ridge, retain spinules only on a median keel. The postorbital ridge extends from the end of the supraorbital ridge series to the upper angle of the gill-cleft; it curves

slightly downward, and bears a series of strengthened scales armed with a single keel, along which eight or fewer rather strong spinules project outward and backward. The occipital ridges are subparallel anteriorly, but diverge posteriorly; the least distance between them is contained 1.8 (1.5 to 1.9) times in the interorbital width; the scales on the occipital ridges bear from one to three (usually one) spinous carinae, but are rougher in small specimens. The median occipital scute bears a single keel in the type and in the larger paratypes, but three ridges in the small paratypes; a similar scute is situated at the origin of the lateral line. A row of enlarged scales, the largest of all, is located midway between the occipital and postorbital ridges; these large scales have seven or fewer divergent carinae; the remaining scales between those ridges are small or minute. The space between the front half of the occipital ridges is covered by five series of scales; the scales of the median series are the largest, and bear 3 (2 to 4) divergent carinae; those of the outermost series on each side are smaller, and bear 2 or 3 carinae; those of the intervening series are minute. The two series of sparsely spinulate scales bounding the median rostral series on each side become narrow anteriorly, so that their lateral margins converge forward and meet the median series just behind the terminal plate. A conspicuous scaleless groove separates these series from the single series bounding the supranarial ridge. An area of scales like those of the body is located behind the upper half of the orbit.

The first dorsal spine is sharp, but very short; the second spine is produced into a filament, and is almost as long as the head in the type. The base of the first dorsal is slightly longer than the length of the interdorsal space in the type, and is contained from 0.9 to 1.2 times in that distance in the paratypes. The anterior rays of the second dorsal fin are comparatively well developed, being 0.3 as long as the orbit. The origin of the anal fin is directly below that of the second dorsal.

The length of the fin rays forms a notable sexually dimorphic character. They are decidedly longer in the males than in the females, as is indicated in the following table:

Table of measurements of length of fins in each sex.[1]

	Males (Paratypes).	Females.	
		Paratypes.	Type.
Second dorsal spine	0.8 to 0.9	1.17 to 1.55	1.02
Pectoral fin	1.15 to 1.50	1.60 to 2.15	1.80
Outer ventral ray	1.3 to 1.4	1.7 to 3.0	1.95
Second ventral ray	Ca. 2.4 to 2.7	2.9 to 3.7	3.27

[1] Expressed in the number of times the length of each ray or fin is contained in the head.

Coloration in alcohol.—The body is dark brown, becoming lighter ventrally, but blackish on the belly. A rounded blackish spot, ocellated by a whitish ring, extends from the lower end of the pectoral base upward and backward to and including the first row of scales above the lateral line; the spot is nearly as long as the orbit and covers about eight rows of scales (counting downward and backward). A less regular and less distinct squarish spot has its four corners at the front of the first dorsal fin, at the origin of the lateral line on each side, and at a point on the top of the head above the posterior orbital margin. Another indistinct blotch lies below the posterior end of the first dorsal and the anterior part of the interdorsal space. A dark bar, half the head's length behind the spot near the pectoral, covers three scale rows extending downward and backward from the dorsal fin to the lateral line. Behind this region the tail is indistinctly barred. The sides of the abdomen and of the head show silvery reflections. The upper end of the branchiostegal membrane, the opercle, and the posterior border of the preopercle are dull blackish. Elsewhere the head is light, being pale and punctate on the under surface, whitish on the mandibular rami, and on the gular and branchiostegal membranes. The buccal and branchial cavities are lined with blackish, except along their light margins. The blackish brown color of the parietal peritoneum, easily rubbed off, is underlain by a bright silvery pigment. The fins are mostly blackish, but are light on the base of the first dorsal, on the entire second dorsal, and on the filament of the outer ventral ray.

This interesting species has been sufficiently compared with related forms in the preceding analytical key.

Table of measurements in hundredths of length to anus.

	Type (female).	Paratype (male).
Albatross station	5621	5621
Total length in mm	[1] 191	169
Length to anus in mm	66	51
Length of head	71	73
Length of orbit	22	22
Postorbital length of head	24	24
Width of interorbital	16	17
Width of suborbital	11	11
Orbit to preopercle	29	28
Length of snout	27	28
Length of barbel	4	6
Length of upper jaw	18	18
Depth of body	41	.....
Width of body	31	33
Anal to anus	10	7
Anus to ventral	23	27
Ventral to isthmus	21	20
Height of second dorsal spine	69	84
Height of third dorsal ray	.....	.....
Length of first dorsal base	17	18
Length of interdorsal space	15	16
Length of pectoral	38	50
Length of outer ventral ray	37	46
Length of second ventral ray	22	29

[1] A pseudocaudal developed.

(*maculatus*, in reference to the large blackish spot which is located just above and behind the pectoral fin in the series of species led by *C. maculatus*.)

25. COELORHYNCHUS VELIFER, new species.

Type-specimen.—Cat. No. 78216, U.S.N.M.; 251 mm. in total length (tail almost entire), 72 mm. to the anus. The type is an adult male, and was dredged at *Albatross* station 5294 (data below).

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5265	Off southwestern Luzon, in the China Sea and adjacent waters.	135		1
5268	do	170		6
5269	do	220		1
5289	do	172		52
5291	do	173	51.5	13
5292	do	162	52.4	1
5293	do	180	57.4	21
5294	do	244	48.4	2
5296	do	210		2
5297	do	198		3
5523	Mindanao Sea			5
	Total			107

This species, so abundantly dredged off southwestern Luzon, was not collected so far south as were *C. notatus* and *triocellatus*, and but one or two of the specimens of *maculatus* were obtained within its known range. The species just named are obviously closely allied, and are mutually characterized by the presence and the form of the ventral fossa, a scaleless strip extending forward from the peritroct to between the ventrals.

The evidence at hand points to the possible conclusion that the young of this species inhabit shallower water than the adults do, although their vertical ranges overlap; only the young were obtained at stations 5265 (135 fathoms), 5268 (170 fathoms), and 5292 (162 fathoms); both the young and adult specimens were dredged at stations 5289 (172 fathoms), 5291 (173) and 5293 (180); only adults were collected at the following stations: 5297 (198 fathoms), 5296 (210), 5269 (220), and 5294 (244).

This species, *C. velifer*, apparently attains a larger size than does *C. maculatus*.

Fin-rays—first dorsal, II, 9 (8 to 10); pectorals, 15 (15 to 17); ventrals, 7.

The body is slender, but more robust than in *C. maculatus*, the greatest depth being contained 1.6 (1.6 to 1.7) times in the head in the adults (the young, as usual, are more slender); the width of the body across the pectoral bases is nearly equal to the depth of the

body below the lateral line (only half the depth in very small specimens). In trimness of form, and in firmness of texture, this species presents an appearance intermediate between *C. maculatus* and *C. notatus*, confirming other intermediate characters, such as the spinulation of the scales and the color. As further evidence of its intermediate position, this species in certain of its characters most clearly resembles each of the other two.

The dorsal contour of the snout, as in *C. maculatus* and *C. macrolepis*, is straight, and the outline behind the snout is nearly straight; the ventral contour is evenly and slightly curved downward behind the mouth. The short, broad, deep, snout, with its widely convex sides, closely resembles that of *C. platorhynchus*, *C. acantholepis*, and *C. carinifer*, which are species of another subgenus. The tip of the snout is blunt, the dorsoterminal plate being little or not at all produced beyond the line of the following scales on the infraorbital ridge; the depth and width of the snout through the terminal plates are about equal.

Table of proportions of parts of head.

	Length of head (mm.).								
	17 to 45.				45.5 to 54.7.				53.5.
	Maximum.	Minimum.	Average.	Number.[1]	Maximum.	Minimum.	Average.	Number.[1]	Type.
Orbit in head	3.05	3.33	3.21	15	3.20	3.50	3.34	17	3.36
Orbit in postorbital	1.00	1.20	1.10	15	1.10	1.30	1.19	17	1.20
Orbit in snout	1.05	1.35	1.18	15	1.15	1.23	1.185	17	1.17
Interorbital in postorbital	1.40	1.70	1.57	15	1.55	1.85	1.68	17	1.67
Maxillary in head	3.55	4.00	3.82	14	3.40	4.00	3.68	13	3.60
Barbel in postorbital	4.90	5.30	.....	3	4.00	5.00	.....	3	.....
Preocular length of snout	2.70	3.00	2.76	15	2.75	2.95	2.84	17	2.82
Preoral length of snout	2.80	3.10	3.00	9	3.00	3.50	3.22	10	3.50
Width of snout	2.50	2.75	2.58	7	2.40	2.95	2.59	10	2.48

[1] The number of specimens on which the given average was based.

The preceding table of measurements clearly shows certain variations of the relative proportions which are correlated with the size of the individual: the orbit becomes smaller in larger specimens, the interorbital narrower, the maxillary longer, and the snout shorter.

A comparison of these measurements with those of *C. maculatus* shows three of the differences which distinguish the two species; the snout is shorter in *C. velifer*, the interorbital narrower, and the mouth larger.

The posteroventral angle of the subopercle is produced backward and downward into a pointed flap. The orbit is of rounded-oblong outline. The interorbital space is narrowest above the front margin of the pupil, behind which point the slightly convex sides rapidly diverge; the least width of the suborbital is less than in *C. maculatus*, being contained 2.5 (2.3 to 2.7) times in the postorbital length

of the head. The maxillary extends slightly beyond the hind margin of the pupil. The outer premaxillary series of teeth are scarcely enlarged. There are six branchiostegals; a narrow free fold is formed behind the attachment of the gill-membranes.

The location of the anus is subject to variation, its distance from the origin of the anal being contained 3.0 (2.0 to 3.7) times in the distance from the anus to base of outer ventral ray, a distance about equal to that from the ventral to the isthmus, and contained 1.15 times (1.0 to 1.2) in the postorbital length of the head.

The ventral fossa in this species is a scaleless strip extending forward from the peritroct. Its shape is variable; in some specimens it is narrow and rectangular, of variable width, but is usually widest anteriorly, as in the type; in one specimen it has an obovate form; its surface is punctate. Above the fossa a peculiar organ is imbedded, resembling that of *C. maculatus*, but apparently differing from it in certain details: it is an elongate, flat body, darkly pigmented on its ventral surface, but wholly silvery on its dorsal surface; a strand of tissue, about as long as the organ, connects it with the peritroct. The organ has no skeletal support.

Table of scale and ridge characters.

Albatross station.	Length of head, mm.	Number of rows of scales above lateral line.	Number of carinae on scales of body.	Number of scales on superior rostral ridge.	Length of dorso-terminal tubercle in postorbital length of head.	Number of scales on ethmoid portion of infraorbital ridge, excluding the terminal tubercle.	Number of scales on preorbital portion of the infraorbital ridge.	Least distance between occipital ridges in least interorbital width.
5292	17	5½						
5291	20.5	5½	3	9	6.0	6—6		
5291	28	5½	5	9	5.5	7—6	10— 9	1.7
5291	32	5½	5	9	4.5	6	8— 9	1.6
5297	40	5½	6 to 8	8	5.4		9	1.9
5289	41	5½	5 to 7	9	4.4	6—6	8—10	1.8
5294	42	5½	5 to 7	9	5.0	6—7	8— 9	1.6
5523	42.5	5½	5 to 7	9	7.3	6—6	8— 9	1.7
5823	44	5	6 to 8	9	5.0	6—6	10—10	1.8
5297	44.5	5½	7 to 10	8	6.0	6—6	8— 8	1.7
5297	45	5½	7	8	5.2	7	8— 9	1.7
5523	46	5½	7 to 8	10	5.9	6—6	9—10	1.8
5523	47	5½	6 to 8	10	6.0	7	8— 9	1.75
5289	47.5	5½	5 to 9	10	5.5	7—7	9— 9	1.8
5523	49	5	6 to 8	9	5.6	6—6	9— 9	1.7
5289	51	5½	6 to 9	9	6.0	7—7	10— 8	2.0
5291	52	6	7 to 10					1.7
5294[1]	53.5	5½	7 to 10	10	7.0	7—6	9— 8	1.8
5269	54.7	5½	7 to 9	8	6.5	7-7	9— 8	1.7
5289	55	5½	7 to 11	10	6.5	6—7	10— 9	1.85
5289	63	5½	6 to 10	8	8.0	6—7	9— 8	1.85

[1] Type.

The spinous carinae of the scales do not approach, either in size or strength, those of *C. maculatus*, but are stronger than those of *C. notatus*. The rather weak spinules on the scales of the body are imbricate upon one another; the last spinule in each series projects but little beyond the margin of the scale; the 11 or fewer spinules on each of the carinae increase but little in strength posteriorly on

the carina. The spinules on the scales of the head are finer and fewer than in *maculatus*. The dorsoterminal plate resembles that of *maculatus*, not being greatly strengthened and modified as it is in *notatus*, *sexradiatus*, and *triocellatus;* it barely projects beyond the marginal line of the following scales. Both the dorsoterminal and the ventroterminal plates are armed by a median and a submarginal series of stout, erect, conic spinules in the type, while in certain paratypes either the median or lateral series (or both) of the upper plate may be irregularly doubled. In the young the spinules of the terminal plates, as those of the other scales, are stronger relatively and fewer in number, but the same arrangement holds true as in the

FIG. 10.—COELORHYNCHUS VELIFER. TYPE.

adult. The number of scales on the ethmoid region of the infraorbital ridge averages fewer than in *maculatus;* they bear spinules arranged in irregular radiating series. The scales of the median superior rostral series are fewer than in *maculatus*, there being 8 to 10, instead of constantly 10; these scales are also armed with more numerous carinae (as many as 10)—the carinae of the last scale, which is not reduced in size, are subparallel, but those on the other scales are arranged in series which radiate or diverge strongly—on the posterior scales, from the middle of the front margin of each scale; on the anterior scales, from a point near the front margin of each scale. The supraorbital series is composed of scales which are largest in front, and are wider and weaker than in *C. maculatus*, all bearing several series of spinules which radiate from near the front margin of the first scales, but from the anteroventral angle of the posterior scales. The scales along the postorbital ridge bear spinules in one to several series, usually in but one.

The occipital ridges, which are nearly parallel anteriorly, but diverge posteriorly, bear scales rather sturdily armed; the anterior

ones usually with several divergent ridges, the posterior ones with but the single median keel persistent in the larger specimens. The median occipital scute is armed by a rather strong median keel, and from one (as in the type) to three lateral divergent series. A similar but smaller scute, located near the origin of the lateral line, is less strongly developed than in *C. maculatus*. The area between the occipital and postorbital ridges is largely covered by three longitudinal series of scales, similar to those on the body; those in the median series, although the largest, are not so much enlarged as in *C. maculatus*. As in *C. maculatus*, five series of scales occupy the area between the occipital ridges; the scales of the median series are the largest, and bear seven or fewer carinae (in the type). The scales bounding the superior rostral ridge form an area similar to that of *C. maculatus*, but are in other respects quite dissimilar: they are arranged in a single series on each side; they are of subquadrate outline, and they are armed in a peculiar and diagnostic fashion: each scale is sharply divided into two regions by that diagonal which extends from the anterolateral angle across the scale to the inner posterior angle; the posterolateral triangular area, thus outlined, is armed by several (four to six in type) parallel or subparallel spinous carinae, while the inner-anterior triangular area bears but one or two spinous ridges coursing inward and backward. The area within the anterolateral margins of the snout, mostly scaleless in *C. maculatus*, is largely covered with prickles in *C. velifer*. The under side of the head, including the branchiostegal membrane, and also the nasal fossa, are wholly naked.

The first dorsal spine is short but sharp, the second is long and filamentous, with a base grooved on its three sides; the anterior edge of the spine is rounded, and is constantly wholly spineless. The base of the first dorsal is a little shorter than the interval between the dorsals. The second dorsal is not so rudimentary anteriorly as it often is, the first ray being contained 4.5 times in the orbit. The anal fin is inserted a little in advance of the vertical from the origin of the second dorsal. The second ventral ray in the type reaches to between the anus and the anal fin.

Table of measurements of length of fins[1] *in the males, young males, and females.*

Nature of specimen.	Type.	Paratypes.		
	Male.	Large males.	Young males.	Females.
Length of head, mm	53.5	42.5 to 55	40 and 42	41 to 63
Second dorsal spine	.805	.80 to 1.05	1.08	1.15 to 1.46
Third dorsal ray	.....	1.08 to 1.16	1.23	1.36 to 1.61
Pectoral fin	1.10	1.10 to 1.39	1.55 to 1.60	1.58 to 2.46
Outer ventral ray	1.38	1.24 to 1.64	1.55 to 1.74	1.71 to 2.22
Second ventral ray	2.45	2.25 to 2.68	2.70 to 2.85	2.72 to 3.60

[1] Expressed in the number of times each ray or fin is contained in the head. The table is summarized from measurements on 30 specimens.

The fin-rays in this species are longer in the male than in the female. As usual in cases of sexual dimorphism, the exaggerated character of the male is less marked in the young than in the adult. The sexual dimorphism of the fin rays shown to occur in several species with elongated dorsal spines (*C. maculatus*, *C. velifer*, *C. sexradiatus*, and probably *C. dorsalis*) is good evidence of their close relationships. It was not noted in those related species in which the dorsal spine is not produced, although there is a wide individual variation in this regard among those species.

The color is somewhat lighter than in *C. maculatus*, but of similar pattern. The body is lighter below, but blackish on the belly. The characteristic brownish black spot of this group of species, located above and behind the pectoral fin, is large and round in *C. velifer;* it includes the first row of scales above the lateral line, and covers 8 or 9 rows counting downward and backward (restricted to 7 or even 6 rows in some paratypes); this spot is ocellated by a lighter band, which includes a whitish spot just below the front end of the lateral line, and a whitish bar just behind the spot. A less distinct spot, square in outline, is irregularly bounded by lines joining the first dorsal spine, the origin of the lateral line on each side, and the median occipital scute. The remainder of the diagnostic color pattern is indistinct in the adult, but is well marked in the young. A broad triangular dark area with its apex ventral, and with its base along the posterior half of the first dorsal fin and the whole interdorsal space, is rather indefinitely ocellated below with a broad lighter band, which is followed by a blotch darkest just above the lateral line. An oblique bar, directed downward and backward to the anal base, and covering 6 to 8 scale rows, is located behind the head a distance nearly or quite equal to the length of the head. Similar but less distinct broad bars cross the tail posteriorly. The sides of the abdomen and of the head show silvery reflections. The upper part of the branchiostegal membranes are blackish, with the exception of the lighter margin to the branchial cavity. The color of the head is light, punctate below. The buccal and branchial cavities are lined with bluish black everywhere except on their margins; the parietal peritoneum is brownish black, underlain with silvery. The fins are dusky, including the base of the first dorsal fin rays, which are light in *maculatus*, but excluding the black filament of the dorsal spine, the light second dorsal fin, and the white outer ventral ray. The intensity of the color on the fins varies widely; the ventral fin is usually blackish, but the entire outer ventral ray and the tips of the other rays are whitish in the lightest specimens.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.				
	Male.	Female.	Male.	Female.	Female.	Young.
Albatross station.	5294	5523	5523	5289	5291	5292
Total length in mm	251	[1] 193	[1] 202	[1] 147	133+	74
Length to anus in mm	72	66	63	54.5	42	21
Length of head	74	75	73.5	76.5	78	84
Length of orbit	22.5	23	23.3	24	26	30
Postorbital length of head	28	27	27	25.5	27	28
Width of interorbital	17	17	17.5	16	17	20
Width of suborbital	11.5	10	10	10.5	11	11
Orbit to preopercle	30	29	28	29	28	31
Length of snout	27	27.5	27	29	29.5	31
Width of snout	31	28	28	30	30	----
Length of upper jaw	21.5	19	19	20	19	21.5
Length of barbel	----	4.1	4.7	4.7	4	----
Depth of body	47	44	45	----	41	41
Width of body	33.5	32	31.5	33	30	28
Anus to anal	8	10.5	11	11	7	8
Anus to ventral	24	23.7	23	23	21	16
Ventral to isthmus	25	24	24.5	21	22	22
Height of second dorsal spine	92	68	68	65+	64	42
Height of third dorsal ray	----	54.5	63	57.5	----	----
Length of first dorsal base	20.5	16	18	17	17	19
Length of interdorsal space	22	22	19	18	20	----
Length of pectoral	67	42.5	61	48	36	36
Length of outer ventral ray	54	40.5	53	48	45	42
Length of second ventral ray	30.5	24.7	31	25	26	----

[1] A pseudocaudal developed.

(*velifer*, in reference to the high dorsal.)

26. COELORHYNCHUS SEXRADIATUS, new species.

Type-specimen.—Cat. No. 78217, U.S.N.M.: a male 205 mm. in total length (a small pseudocaudal developed), 66 mm. to anus, dredged at *Albatross* station 5172.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5172	Vicinity of Jolo	318	----	Type+1
5565	Between Jolo and Tawi Tawi	243	52.3	6

Fin-rays—first dorsal, II, 8 (or II, 9); pectoral, 14 (or 15); ventral, 6—6 (as also in 6 paratypes, but 6—7 in the only other one). Pectoral and ventral rays fewer than in *C. notatus*.

Greatest depth of body, 1.78 (to 1.72) in head; width over pectoral bases, 2.30 (2.25 to 2.50), being a little less than the depth of the body below the origin of the lateral line. In a smaller specimen, 55 mm. long to anus, the depth is 1.85 and the width 2.64 in the head.

The dorsal contour of the snout is concave; the snout is broadest at its base, its lateral contours converging forward in a curve less convex than in *C. maculatus* and *C. velifer*, but rather more convex than in *C. notatus* or *triocellatus*. The tip of the snout is sharp, as the terminal plate projects beyond the margin of the following scales.

Summarized table of proportions of parts of head.

	Type.	Maximum.	Minimum.	Average.[1]	Young.
Length of head in mm	49.5	57			43
Orbit in head	3.50	3.50	3.90	3.68	3.55
Orbit in postorbital	1.15	1.15	1.34	1.27	1.15
Orbit in snout	1.33	1.30	1.55	1.40	1.40
Interorbital in postorbital	1.55	1.55	1.85	1.72	1.65
Maxillary in head	4.05	3.70	4.05	3.86	4.10
Barbel in postorbital		3.40	4.60	4.07	4.00
Preocular length of snout	2.50	2.48	2.60	2.56	2.48
Preoral length of snout	2.95	2.90	3.05	2.98	3.10
Width of snout	2.50	2.50	2.85	2.67	2.70

[1] Based upon 5 to 7 specimens in each case (type included).

The preceding table indicates certain of those differences which distinguish *C. sexradiatus* from *C. notatus*, the snout being longer and the orbit smaller.

FIG. 11.—COELORHYNCHUS SEXRADIATUS. TYPE.

The posteroventral angle of the subopercle is sharply produced backward (and slightly downward). The interorbital width is least above front of pupil; least suborbital width, 2.5 (to 2.7) in postorbital. The maxillary subtends the anterior two-thirds of the orbital length. Bands of fine teeth occur on the jaws; the outer premaxillary series is not enlarged. Six branchiostegals. The gill-membranes form a narrow free fold across the isthmus.

The anus is located near the origin of the anal fin, the interspace being contained 3.7 (to 2.9) times in the distance between the anus and the base of the outer ventral ray, which is contained 1.05 (to 1.4) times in the postorbital length of the head. The distance between the outer ventral ray and the isthmus is slightly shorter than the distance between the anus and the ventral fin (slightly longer in one paratype).

A narrow, darkly pigmented, naked fossa, widening anteriorly, extends forward from the anus to between the front of the ventral bases.

The lateral line series of scales is separated by $5\frac{1}{2}$ (5 or even $4\frac{1}{2}$) rows from the origin of the second dorsal fin. There are 8 to 12 parallel spinous carinae on the scales of the body in the type and large paratypes, but fewer on the smaller specimens. These carinae are less rugose than in the preceding two species; each is armed with as many as 14 rather weak retrorse imbricate spinules, which increase somewhat in size posteriorly, so that the last one projects a little beyond the margin of the scale. The scales of the head are much smoother and more prefectly imbricate than in *maculatus* or *velifer*, but less so than in *notatus*. The highly specialized ridge scales of the head are so similar to those of *notatus* that only the following diagnostic characters need be described. The dorsoterminal plate is more prominent, its length being contained 4.2 (4.4 to 5.2) times in the postorbital. There are but 5 to 7 scales on the ethmoid portion of the infraorbital ridge. The median occipital scute is armed by a single strong keel in the type, while in some of the paratypes a smaller pair of divergent lateral carinae are added; in all the specimens except one paratype, an additional scute, not so strongly modified, is located on the mid-dorsal line at the end of the first third of the distance between the first scute and the origin of the dorsal fin. The median of the three series of scales between the occipital and postorbital ridges is markedly enlarged. A few small scales posteriorly partially replace the prickles which in *C. notatus* largely cover the fossa within the anterolateral margins of the snout; this region is consequently naked to a wider extent. The carinae on the opercular scales are mostly subparallel. The under surface of the head, the gill-membranes, and the nasal fossa are completely scaleless.

The fins are essentially like those of related species. The similarity apparently includes the sexual dimorphism as regards the length of the fins, but the data for this species are meager, as in many cases the fins are broken.

Table showing length of fin-rays in the two sexes.

	Male.		Female.
	Type.	Paratypes.	Paratypes.
Length of second dorsal spine	0.94	0.093 to 0.096	.....
Length of third dorsal ray	1.55	1.4	.....
Length of pectoral fin	1.9	1.75 to 2.0	2.1 to 2.15
Length of outer ventral ray	1.67	1.6 to 1.9	2.0 to 2.05
Length of second ventral ray	3.0	2.95 to 3.32	3.5 to 3.6

Base of the first dorsal contained 1.25 (1.0 to 1.4) times in the interdorsal space, and 1.5 (1.4 to 1.8) times in the postorbital length of the head. The origin of the anal lies below either the middle or the posterior part of the interdorsal space.

Coloration in alcohol.—The ground color is lighter than in *C. notatus*, *velifer*, or *maculatus;* the belly is dark, becoming blackish between the ventral fins. An ocellated blackish spot extends upward and backward from the pectoral onto the first row of scales above the lateral line, covering 6 (5 to 7) rows of scales extending downward and backward. There is a dusky blotch between the first dorsal fin and the occiput, and only faint traces of a dusky saddle representing the well-defined marking in *C. notatus*. The dark lining of the buccal cavity becomes light near the gape; the light margin along the outer edge of the branchiostegal membranes widens ventrally; the parietal peritoneum is pale purplish brown, punctulate, and underlain with silvery. The whitish proximal color of the first dorsal shades into black distally. The second dorsal and the anal fins are light, the anal becoming uniformly dark anteriorly. The ventral fin is dark except on the distal and larger portion of its first ray; the pectoral fin, otherwise light, is darkened on its uppermost two rays.

C. sexradiatus differs from the nearest relative, *C. notatus*, in many points: the fewer rays in the paired fins; the more convex margins of the snout; the longer and more prominent dorsoterminal plate; the more posterior position of the anus; the longer ventral fossa; the somewhat smoother carinae on the scales; many details, as outlined heretofore, in the squamation of the head; the lighter color, with but traces of the dark saddles so characteristic of *notatus*.

Table or measurements in hundredths of length to anus.

	Type.	Paratype.
Albatross station	5172	5565
Total length in mm	[1] 205	[1] 153
Length to anus in mm	66	53
Length of head	75	81
Length of orbit	22	22.5
Postorbital length of head	27	27
Width of interorbital	16.5	17
Width of suborbital	11	10
Orbit to preopercle	31	30
Length of snout	30	33
Length of upper jaw	19	19
Length of barbel	5	7
Depth of body	42	44
Width of body	33	31
Anus to anal	7	7
Anus to ventral	25	19
Ventral to isthmus	22	23.5
Height of second dorsal spine	91	.....
Height of third dorsal ray	51	.....
Length of first dorsal base	16.5	18
Length of interdorsal space	21	20
Length of pectoral	42	40
Length of outer ventral ray	43	42
Length of second ventral ray	24	23

[1] A small pseudocaudal developed.

(*sexradiatus*, in reference to the number of ventral rays, which appears to be characteristic to this species.)

27. COELORHYNCHUS NOTATUS Smith and Radcliffe.

Coelorhynchus notatus Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 136 (type-specimen only), pl. 30, fig. 3.

For the purpose of presenting a full comparison with the several closely related species which we are now describing, we have prepared a detailed description of this species.

Type-specimen.—Cat. No. 72948, U.S.N.M., is the only representative of this species in the collection. It is a mature female, measuring 268 mm. in total length to the broken tip of the tail, and 84 mm. to the center of the anus. These measurements indicate that *C. notatus* is probably a larger species than any of the closely related forms with the exception of *C. velifer*. The type was dredged at *Albatross* station 5162, in Alice Channel, which connects Sulu Sea with Celebes Sea; depth, 230 fathoms; bottom temperature, 52.9° F.

Dorsal rays, II, 9; pectoral, 17 (including the uppermost spine); ventral, 7.

Greatest depth of the body, 1.7 in head; width over pectoral bases, 2.25 in head, less than the depth below the origin of the lateral line. The concavity of the dorsal contour of the snout is well shown in the type figure; the lateral margins of the snout are much less strongly convex than in *maculatus* or *velifer;* they converge rather rapidly forward. The tip of the snout is sharper than in *C. maculatus* or *velifer*, but somewhat blunter than in the other closely related species; the snout near its tip is wider than deep; the terminal plate projects but little beyond the general contour of the snout. The preocular length of the snout is contained 2.71 times in the length of the head (63 mm.); the preoral length, 3.00 times; width of snout opposite front of orbits, 2.70 times. The posteroventral angle of the subopercle is produced backward as a rather bluntly pointed flap. Length of the orbit, 3.40 in head, 1.15 in postorbital length of the head, 1.28 in snout. The least interorbital width, above the front of the pupils, is contained 1.75 times in the postorbital; least suborbital width, 2.60 times. The length of the upper jaw is contained 3.75 times in the head; the maxillary subtends the anterior two-thirds of the orbital length. The outer premaxillary series of teeth is scarcely enlarged. Length of the barbel, 3.40 in postorbital. Branchiostegal rays, 6. A narrow free fold is formed on the median line behind the attachment of the gill-membranes.

The anus is remote from the anal fin, the interspace being contained 1.6 times in the distance from the anus to the base of the outer ventral ray, a distance which is slightly shorter than the orbit. The interval between the isthmus and the base of the ventral fin is contained 1.07 times in the postorbital, and is 1.1 times as long as the distance from the ventral base to the isthmus.

A darkly pigmented and narrow ventral fossa extends forward, with increasing width, to a line joining the posterior ends of the ventral bases; the length of the fossa, measured from the center of the anus, is equal to the distance between the anus and the anal origin.

There are 5½ scales in a series from the origin of the second dorsal to, but excluding, the lateral line scale. The spinous carinae on the scales of the body, 7 to 9 in number, are of moderate strength, being much smoother than in *maculatus*, a little smoother than in *velifer*, and slightly rougher than in *sexradiatus*. These carinae are armed with as many as 11 slender spinules, which are directed backward, and are imbricate on one another; the last spinule projects beyond the margin of the scale; the spinules increase but little in size posteriorly on each carina. The scales are more completely imbricate than in *C. maculatus* or *velifer*. The length of the dorsoterminal plate is contained 5.2 times in the postorbital; it is armed by 5 double series of spinules; the ventroterminal plate bears 5 single series. Following the terminal plate, on the ethmoid portion of the infraorbital ridge, are 7 scales, which become larger posteriorly, and are armed with radiating rows of spinules; the first scale in this series, bounding the terminal plate, is somewhat modified and enlarged. No interspace separates the ethmoid from the preorbital series, which is composed of 9 or 10 subquadrate scales armed with spinules radiating upward on the first scales from near the middle of their lower margins, but on the last scales from near their anteroventral angles. The scales on the two following regions of the ridge—namely, the suborbital and the preopercular—are arranged in two series, and bear carinae diverging strongly upward and backward. The median superior rostral ridge is covered by 10 oblong scales, which are armed with numerous tubercular spinules aligned in 12 or fewer series radiating from near the anterior margin of each, the point of radiation being nearest the margin on the anterior scales. The supranarial ridge is covered by rough scales increasing in size posteriorly, and armed with spinous carinae diverging strongly from the anteroventral angle of the scale; four scales cover the ridge which separates the upper half of the nasal fossa from the orbit.

The seven strong scales along the supraorbital ridge are flat anteriorly, but convex and narrower posteriorly; they are armed with series of spinules diverging widely backward. The supraorbital ridge scales are bounded within by a narrow naked groove, which is not developed in *C. velifer*. After an interspace as long as a scale, the supraorbital series is followed by the postorbital series of scales, which are narrow, and bear either a single spinous keel, or three divergent carinae. The occipital ridges, from their origin opposite

the third and largest scale of the supraorbital series, extend backward, nearly parallel with one another, to the occiput, behind which point they diverge; the least distance between the center of the ridges is contained 1.7 times in the least interorbital width; the scales on the occipital ridges are armed with 2 to 5 divergent spinous carinae. The median occipital scute bears two long spinous ridges, parallel anteriorly, divergent posteriorly. The scute at the origin of the lateral line, weaker than in *C. maculatus*, is armed with a median spinous keel, and a weaker spinous ridge below. Three series of scales occupy the region between the occipital and postorbital ridges; these differ from those of *C. velifer* and especially from those of *C. maculatus* in the fact that the scales of the median series are scarcely enlarged. Five series of the scales cover the area between the occipital ridges. The outer pair of series and the median series are of subequal size, somewhat smaller than the scales of the body, and differing from them chiefly in the greater divergence of their carinae; the scales of the inner pair of series are reduced in size. As in *C. velifer*, the scales bounding the median rostral ridge are in a single series, the margins of which rapidly converge anteriorly, meeting the rostral ridge just behind the terminal tubercle; these scales are armed on the outer and posterior portion by about six long and slightly divergent carinae bearing suberect spinules, but on the inner portion by a few carinae extending obliquely inward and backward; the scales of these series are rounded, and the peculiar arrangement of carinae is much less strongly developed than in *C. velifer*. A series of rather small scales, continuous with the occipital ridge, becoming irregular above the front margin of the orbit, bounds the inner margin of the supraorbital and supranarial series, and abruptly terminates opposite the front of the nasal fossa. Between this series and that bounding the median rostral series there extends a naked groove, which, after continuing forward with increased width to the terminal plate, abruptly turns back and bounds within the scales along the anterolateral margin of the snout. The remaining portion of the snout above is covered with prickles. The scales on the opercles are not reduced in size and bear as many as 12 divergent carinae. The scales below the orbit, extending from the nasal fossa to the preopercular ridge, are small. The underside of the head and the nasal fossa are wholly scaleless.

The short but sharp first dorsal spine is two-thirds as long as the terminal tubercle; the filamentous second spine is contained 1.21 times into the head.[1] The base of the first dorsal fin is contained 1.2 times in the interdorsal space, or 1.4 times in the postorbital length

[1] The statement of Radcliffe (p. 136) that the dorsal spine is "frequently longer than head in smaller specimens" is not pertinent, inasmuch as none of those smaller specimens are true *notatus*.

of the head. The second dorsal is lower anteriorly than in *C. maculatus* or *velifer*, its first ray being contained 7.5 times in the orbit. The anal fin originates in advance of the second dorsal a distance one-third as great as the interval between the dorsals. The pectoral fin is short; the outer ventral ray is contained 1.95 times in the head; the second ray, 3.15 times.

Coloration in alcohol.—Ground color, light brown, with silvery reflections on the sides of the head and trunk; the color is lighter than in *maculatus* or *velifer*. The belly is blackish only in advance of the ventrals (no such restriction of the black area occurs in *maculatus*, *velifer*, nor *triocellatus*). A large blackish brown imperfectly ocellated spot, extending from the pectoral fin to the lateral line, covers six scale rows counting downward and backward; it is thus smaller than in *C. maculatus* or *C. velifer*. A dark area, not well defined, extends from the first dorsal fin to the occiput; a dark spot, of irregular outline (too sharply emphasized in the type figure), is located before the origin of the lateral line. An ocellated saddle of dark brown color, covering six scale rows, extends across the back downward to the lateral line; it is separated from the pectoral spot by a distance enterring twice into the head; a saddle of similar width, but not ocellated, is separated from the anterior saddle by a distance contained 1.75 times in the head; the tail is indistinctly barred behind these saddles. The opercles are dusky, becoming blackish toward the opercular angle. The buccal cavity is lined with light around the mouth and with dark dusky blue within; the branchial cavity is lined with purplish black except along the light margin of the outer wall; the abdominal cavity is lined with pale purplish brown, punctulate with darker, and underlain by silvery pigment. "Basal sixth of second dorsal spine light brownish yellow, distal portion dusky black, the dark markings of the spine extending onto distal portion of soft rays; second dorsal light; basal portion of anal light, distal portion of fin anteriorly almost black; ventrals dusky black, filament of outer ray whitish; pectoral dusky white," its uppermost two rays dark.

Measurements in hundredths of length to anus (84 mm.).—Length of head, 75; length of orbit, 22; postorbital length of head, 25; least width of interorbital, 15; least suborbital width, 10.5; distance from orbit to preopercle, 28; length of snout, 28; width of snout, 29; length of upper jaw, 20; length of barbel, 7; depth of body, 46.5; width of body across pectorals, 31.5; distance from center of anus to origin of anal, 15; distance from anus to base of outer ventral ray, 20.5; distance between ventral and isthmus, 23; length of first dorsal base, 18; interdorsal space, 22.5; length of outer ventral ray, 40.

Only the type-specimen is known.

(*notatus*, designated by a mark.)

28. COELORHYNCHUS TRIOCELLATUS, new species.

Type-specimen.—Cat. No. 78218, U.S.N.M.; a male 190 mm. long to the end of a pseudocaudal, 65 mm. to the anus; dredged at *Albatross* station 5575, north of Tawi Tawi, at a depth of 315 fathoms, where the bottom temperature was recorded as 52.3° F.

This species, quite handsomely marked for a bathybial type, is closely related to both *C. notatus* and *sexradiatus*, but resembles *notatus* most. Comparison between these forms has already been given in the analytical key to the species of *Coelorhynchus*, and will be repeated in some detail in the course of the following description. *C. triocellatus* is also related to the following species, which, however, lacks the ventral fossa.

Fin-rays—first dorsal, II, 9; pectorals, 17–16; ventrals, 7–7.

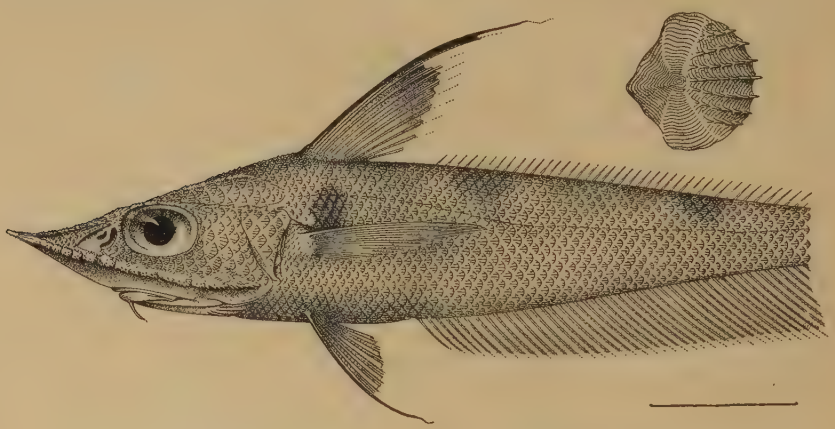

FIG. 12.—COELORHYNCHUS TRIOCELLATUS. TYPE.

The body is slender and comparatively strongly compressed; its greatest depth is contained 1.9 times in the head; its width across the pectoral bases, 2.5 times, being equal to the depth of the body below the origin of the lateral line, or to the total depth of the body at a point twice the head's length behind the tip of the snout; at that point the width of the body is contained 3.4 times in the depth. The dorsal contour is concave on the snout, but straight on the postorbital portion of the head, and horizontal on the tail behind the first dorsal fin. The snout in this species is diagnostically long, slender, and sharply pointed, with sides but little convex. Its preocular length is contained 2.32 times in the head; the preoral length, 2.45 times; its width opposite front of the orbits, 3.0 times. The posteroventral angle of the subopercle is produced backward into a pointed flap. Length of the orbit, 3.6 in head, 1.05 in postorbital, 1.6 in snout; least interorbital width, 1.6 in postorbital; least suborbital

width, 2.5. The maxillary subtends the anterior two-thirds of the orbit; the length of the upper jaw is contained 4.5 times into the head. The villiform teeth, as usual, are in bands on the jaws; the outer premaxillary series is scarcely enlarged. The short barbel is contained 5.7 times in the postorbital. Six branchiostegals; gill-membranes with a free fold.

In the location of the anus this species occupies a position intermediate between that of *C. notatus* and that of *C. sexradiatus*, the distance from the center of the anus to the origin of the anal being contained 2.6 times in the distance between the anus and the base of the outer ventral ray; the latter distance is contained 1.1 times in either the postorbital or the distance from the ventral fin to the isthmus.

A darkly pigmented and very narrow ventral fossa extends forward from the peritroct only to opposite the posterior ends of the ventral bases.

The scales are in $5\frac{1}{2}$ series from the origin of the second dorsal to but excluding the lateral line scales. The spinous carinae on the scales of the body, 7 to 10 in number, are similar in strength to those of *notatus*, but bear 9 or fewer longer, sharper, and more curved spinules; these spinules are much longer, sharper, more slender, and more widely spaced than those of *C. sexradiatus*. The squamation of the head is so similar to that of *C. notatus* that only the features apparently diagnostic need be described. The scales as a whole differ in bearing fewer carinae and fewer spinules. The acute dorsoterminal plate is much longer than in any of the preceding species, its length being contained only 2.9 times in the postorbital; its spinules are arranged in three series radiating from its tip, being much reduced in size along the double median series. There are 6 scales on the ethmoid, 7 or 8 on the preorbital, series of the infraorbital ridge, and 9 on the mediorostral ridge. The median of the three spinous ridges on the occipital scute is the strongest; a scale nearly half the distance from the scute to the dorsal fin is enlarged and strengthened after a somewhat similar fashion. The median of the three series of scales between the occipital and postorbital ridges is enlarged. The anterolateral region of the snout is largely covered with prickles, leaving only a narrow naked groove lateral to the single series of scales bounding the median rostral row. In addition to these prickles, and to the longer dorsoterminal plate, the scales on the head of *triocellatus* differ from those of *sexradiatus* chiefly in bearing fewer and more divergent carinae. The underside of the head and the nasal fossa are completely scaleless.

The first dorsal spine is very short, stout, and sharp; the second is long and filamentous,[1] being contained 1.12 times in the head (the

[1] The fin-rays are probably shorter in the female.

spine is broken at its extreme tip); the third ray is longer than in *C. sexradiatus*, being contained 1.21 times in the length of head. The base of the first dorsal fin is contained 1.2 times in the interdorsal space, or 1.4 times in the postorbital length of head. The second dorsal fin is rather low anteriorly, the first ray being contained 6.3 times in the postorbital. The origin of the anal is anterior to the vertical from the middle of the interdorsal space. Pectoral fin, 1.6 in head; outer ventral ray, 1.75; second ventral ray, 2.85, reaching a little beyond the origin of the anal.

The ground color is a little lighter than in *sexradiatus* or *notatus*, and much lighter than in *maculatus* or *velifer*. The dark shade of the belly extends from the anus to the isthmus and on the sides to above the ventrals. The blackish brown spot above the pectoral extends upward to the lateral line and covers six scale rows. A dusky region, of squarish outline, extends from the first dorsal forward to the occiput, and downward on each side to the origin of the lateral line; it bounds the upper anterior margin of the light area about the suprapectoral spot. A dusky area which extends downward and backward to the lateral line is separated from the spot by an interval shorter than in *notatus* (being but two-fifths as long as the head); a similar but smaller, and only faintly ocellated saddle, is separated from the first by an interval half as long as the head. A black spot, located on the sides of the branchiostegal membranes, is separated from the free edge by a narrow whitish line. The opercle is dusky, with a small blackish spot near its angle. The first dorsal fin is dusky black only on the spine and on the distal portion of the anterior soft rays; it is whitish elsewhere. The second dorsal fin is light; the anal is dark anteriorly, especially toward the tips of the rays. The ventral fin is chiefly dusky, becoming darker distally, blackish near its base, and whitish on the filament of the outer ray. The pectoral rays, with the exception of the uppermost two, are light.

The differences between *C. triocellatus* and *notatus* may be summed up as follows: the body is more strongly compressed; the snout is much longer, narrower, and more acute; the dorsoterminal plate is much longer; the anus is more posterior in position; the spinules on the scales of the body are longer; other differences exist in the squamation of the head and in the coloration. *C. triocellatus* differs from *sexradiatus* in several characters: the body is more compressed; the snout is longer, narrower, more acute; the anus is located farther forward; the ventral fossa is shorter; the pectoral and ventral rays are more numerous; the coloration is more variegated; additional differences in squamation have been noted in the description.

Measurements in hundredths of length to anus (65 mm).—Length of head, 78; length of orbit, 22; postorbital length of head, 23; least interorbital width, 14; least suborbital width, 9; distance between orbit and margin of preopercle, 25; length of snout, 34; width of snout, 27; length of upper jaw, 18; length of barbel, 4; depth of body, 43; width of body across pectorals, 31.5; distance from origin of anal to center of anus, 9; distance from anus to base of outer ventral ray, 20; distance between ventral and isthmus, 24; length of second dorsal spine, 69+; length of third dorsal ray, 66; length of first dorsal base, 16; length of interdorsal space, 18; length of pectoral, 49; length of outer ventral ray, 44; length of second ventral ray, 28.

(*triocellatus*, in reference to the three ocellated marks.)

29. COELORHYNCHUS DORSALIS, new species.

Type-specimen.—Cat. No. 78219, U.S.N.M.; a male, 200 mm. long (extreme tip of tail broken off), 59 mm. to anus, dredged by the steamer *Albatross* at station 5329, in 212 fathoms, off northern Luzon, where the bottom temperature was recorded at 51.4° F.

A single paratype, 155 mm. long to the end of its pseudocaudal, about 47 mm. to anus, was taken near the type-locality, at station 5326; depth, 230 fathoms; bottom temperature, 55.4° F.

This species is the only one of the *C. notatus* group known from off northern Luzon, and was not taken off southern Luzon, where *C. velifer* and *macrolepis* were dredged in abundance.

Fin-rays—first dorsal, II, 8; pectorals, 17—17 (17—16 in paratype); ventrals, 7—7.

In its form this species is somewhat more slender than usual, its greatest depth being contained 1.95 times in the head (1.88 times in the paratype); width of body across pectoral bases, 2.75 (2.6) times; at a point twice the length of the head behind the rostral tip the width of the body is just one-third of the depth. The dorsal contour of the snout is somewhat concave; that of the postrostral portion of the head is nearly straight, not being elevated at the occiput. The snout is long and diagnostically broad anteriorly, being especially wide between the comparatively prominent anterolateral angles, where the width is a little greater than either the orbital length or the length anterior to the angle on either side. The preocular length of the snout is contained 2.37 times in the head; preoral length, 2.7; width opposite front of orbits, 2.9 (2.8). The subopercle is produced backward and downward, from its lower angle, as a pointed flap. Length of orbit, 3.6 in head (3.7 in paratype); 1.1 (1.15) in postorbital; 1.5 (1.6) in snout. Least interorbital width, 1.7 (1.6) in postorbital; least suborbital width, 2.6 (2.7). The upper jaw, contained

4.15 (4.2) times in the head, extends backward almost to below the hinder margin of the pupil. The outer series of premaxillary teeth are scarcely enlarged. The free portion of the small barbel is contained but 7.2 (6.2) times in the postorbital. The gill-membranes cross the isthmus with a narrow free fold; six branchiostegals.

The center of the anus is distant from the anal, the interspace being half the distance from the anus to the base of the outer ventral ray, a distance which is contained 1.2 times in that between the ventral and the isthmus, or 1.3 (1.4) times in the postorbital. There is no trace of a ventral fossa in front of the anus nor between the ventrals.

The scales are smaller and more closely imbricate than in the following species, there being 6½ in a series from the origin of the second dorsal fin to the lateral line series. The scales are less strongly

FIG. 13.—COELORHYNCHUS DORSALIS. TYPE.

spinous than in *argus* and *macrolepis*, but their carinae are more distinctly developed, numbering 8 to 11 on each scale (5 to 7 in the smaller paratype). Each of the carinae bears 12 or fewer short, sharp, close-set spinules directed backward, the last one projecting slightly beyond the margin of the scale. In general the squamation of the head is similar to that of *notatus*, *sexradiatus*, and *triocellatus*, but a few differences are apparent: the carinae on most of the scales of the head are similar to those of the body; they are usually more divergent, weaker, and smoother than in the preceding species. The dorsoterminal plate is shorter than in *triocellatus* but more prominent than in *notatus* and *sexradiatus;* its dorsal length is contained 3.3 times in the postorbital (4.1 times in the paratype). Seven scales cover the ethmoid portion, and 10 or 11 (9) the preorbital portion of the infraorbital ridge. Over the mediorostral ridge there are but 8 narrow scales, each more oval than in the preceding three species, and armed with spinous carinae radiating from near the center of

the scale. Between the occipital ridges the scales, in five series, are mostly little modified, but become reduced in size near the median occipital scute; this scute bears a strong median and a weak lateral keel; there is no second scute between this one and the dorsal fin; a scute near the origin of the lateral line bears a strong spinous crest, with a weaker ventral carina. The scales in the median of the five series between the occipital and the postrostral ridge series are markedly enlarged, some bearing as many as 13 divergent carinae. As in *notatus* and *triocellatus*, as distinguished from *sexradiatus*, the fossa within the anterolateral margin of the snout is largely covered by prickles, leaving only a narrow groove along the outer side of those series of scales which bound on each side the median rostral ridge scales; the scales of these series are similar to those of preceding species, bearing an outer subparallel and an inner oblique group of carinae; posteriorly, small scales are inserted between the main series and the median rostral series. The underside of the head bears no scales.

The first dorsal spine is short and strong; the second is long, and it terminates in a long filament; the third ray is as long as the snout plus the orbit. The base of the first dorsal is contained 1.3 times in the interval between the dorsals, and 1.5 times in the postorbital length of the head; the second dorsal fin is rather low anteriorly. The origin of the anal fin lies below the anterior portion of the interdorsal space. The pectoral is contained twice in the head; the second ventral ray reaches the anal origin.

As a wide sexual dimorphism was demonstrated in *C. maculatus*, *velifer*, and *sexradiatus* as regards the length of the fin-rays, a comparison of these characters is added, based upon the type, a male, and the paratype, a smaller female. Although the difference is less striking, it is probable that in this species, too, the fin-rays are longer in the male than in the female.

Table of fin-ray measurements.

	Type (a male).	Paratype (a female).
Dorsal spine into head	0.9	1.2
Pectoral fin into head	2.0	2.0
Outer ventral ray into head	1.95	2.2
Second ventral ray into head	3.15	3.3

The ground color is light, about as in *C. triocellatus*. The dusky shade of the belly extends forward to, or nearly to, the isthmus, and on the sides to above the ventrals, thus distinguishing this species from *notatus* and *sexradiatus*. The markings of the two specimens are not strong. The large spot above and behind the pectoral in-

cludes the first row and a half of scales above the lateral line, and covers eight oblique rows (six in paratype); this spot is ocellated by a wide lighter band, which is immediately preceded and followed by rather indistinct saddles, similar to those of related species. After an interspace three-fourths as long as the head, the dark spot is followed by the usual dark saddle, which in this species is quite indistinct. The head is lightly colored, with silvery reflections as on the sides of the body; the opercle is dusky; the margin of the branchiostegal membranes laterally is whitish. The buccal cavity and the upper two-thirds of the branchial cavity are lined with a dusky membrane; the parietal peritoneum is light purplish brown, blotched with darker and underlain with silvery. The first dorsal is mostly dark, but lighter near its base, and near the tip of the spine; the second dorsal is light; the anal fin has a dark margin, which is widest anteriorly. The pectoral fin is almost whitish, except on its upper margin; the ventral is dusky, with a blackish base.

This interesting species is similar to the last one described, *C. triocellatus*, but differs notably in lacking the ventral fossa, in its plainer coloration, etc. It is also closely related to the next species, *C. argus*, from which it differs in the produced dorsal spine, in the broader snout with more convex sides, and in details in the squamation of the head. From both of these species, *C. dorsalis* differs also in its finer scales, there being $6\frac{1}{2}$ instead of $5\frac{1}{2}$ scales in a row between the origin of the second dorsal and the lateral line series.

Measurements of type in hundredths of length to anus.—Length of head, 76; length of orbit, 21; postorbital length of head, 24; width of interorbital, 17; width of suborbital, 9; distance from orbit to preopercular margin at angle, 28; length of snout, 32; length of upper jaw, 18; length of barbel, 3.7; depth of body, 39; width of body, 26; distance from center of anus to origin of anal, 9; distance from anus to base of outer ventral ray, 18.5; distance from base of outer ventral ray to isthmus, 22; height of second dorsal spine, 84; height of third dorsal ray, 51; length of first dorsal base, 16; length of interspace between dorsals, 20.5; length of pectoral fin, 40; length of outer ventral ray, 39; length of second ventral ray, 25.

(*dorsalis* in reference to high dorsal fin.)

30. COELORHYNCHUS ARGUS Weber.

Coelorhynchus argus Weber, Fische der *Siboga*-Expedition, 1913, p. 161, pl. 4, fig. 4 and 4*a*.

We hesitate to refer our specimens to *C. argus*, as certain discrepancies between them and Weber's description are difficult to explain. The orbit is never quite as long as the postorbital length of the head, as we measure these parts, either in our specimens or in Weber's figure, but his measurements indicate the reverse. The interorbital

in our material is always less than half the length of the snout, but to a variable degree. Weber[1] finds only 2 specimens out of 19 in which the snout is more than twice as long as the least interorbital space. These differences may, however, be due to different methods of measurement. The methods which we follow are clearly given in the introduction to our paper on Japanese Macrouroids.[2] *C. argus* can not be identified with any other of the seven species of the *C. notatus* group, all of which are described in these pages.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			F.°	
5387	Between Burias and Luzon	209	52.4	1
5112	China Sea, off southern Luzon	177	52.4	1
5118	....do	159		1
5265	....do	135		1
5291	....do	173		8
5298	....do	140		2
5421	Between Panay and Guimaras Islands	159		1
5247	Gulf of Davao, southern Mindanao	135		2
5549	Near Jolo Islands	232	53.5	4
5135	....do	161	57.4	3

We have prepared a detailed description of our material:

Fin-rays—first dorsal, II, 7 to 9; pectoral, 14 to 17; ventral, 7.

The dorsal contour varies somewhat, that of the snout being more or less concave, while that behind the snout is more or less convex. Greatest depth of body, 1.85 to 2.0 in head; width across pectoral bases, 2.6 to 2.9, equal to, or somewhat less than, the depth of the body below the origin of the lateral line. The dorsal contour is not elevated at the occiput. The snout is narrow anteriorly as in *notatus*, *sexradiatus*, and *triocellatus*, its sides being quite evenly convex forward to just behind the produced dorsoterminal plate, the length of which is contained from 2.9 to 3.9 times in the postorbital. In some specimens the anterolateral angles of the snout are fairly prominent, while in others they are scarcely apparent. Preocular length of snout, 2.2 to 2.5[3] in head; preoral length, 2.4 to 2.9; width of snout opposite front of orbits, 2.7 to 3.05. The width of the snout at the posterior end of the ethmoid region of the infraorbital ridge is about equal to the length of the orbit, and is contained from 1.0 to 1.25 times in the distance from that point to the tip of the snout. The subopercle has the usual pointed flap. The orbit is of rounded-oblong outline, its length being contained from 3.4 to 3.8 times in the head; 1.0 to 1.1 times in the postorbital length to the edge of the

[1] Doctor Weber has kindly reexamined his material as regards this and other points which were of interest to us.

[2] Proc. U. S. Nat. Mus., vol. 51, 1916, p. 147.

[3] These measurements of the parts of the head were made on each of about 12 specimens, in which the heads measured from 41 to 53 mm.

membrane at the opercular margin; 1.4 to 1.7 times in the snout. The least interorbital width is located above the front of the pupil, and is contained 1.5 to 1.8 times in the postorbital; the least suborbital width, 2.6 to 2.7. The upper jaw extends backward almost or quite to the vertical below the hind margin of the pupil, and is contained from 3.95 to 4.8 times in the head. Bands of fine teeth occur in the jaws; the outermost premaxillary series is somewhat enlarged. Barbel, 4.0 to 7.0 in postorbital length of head. Six branchiostegals; the gill-membranes have a free fold of variable width.

The center of the anus lies in advance of the origin of the anal fin a distance half to two-thirds that between the anus and the base of the outer ventral ray; the distance from anus to ventral is contained 1.25 to 1.5 times in the distance from the ventral to the isthmus, or in the postorbital length of the head. No trace of a scaleless ventral fossa can be found in specimens in which no scales are lost, but the scales are often fallen in an area before the anus. A gland-like body extends forward from the peritroct to between the ventrals, above the position occupied by the ventral fossa in those species in which the fossa is present; this organ is slender posteriorly, but widens anteriorly to an ellipsoidal form; its ventral surface is black, in strong contrast to its silvery dorsal face.

The scales are less closely imbricate than in *C. dorsalis;* they are constantly in $5\frac{1}{2}$ rows between the lateral line and the origin of the second dorsal. The scales of the body are moderately rough, being more strongly spinose than in *C. dorsalis.* Each scale is armed with 5 to 10 well-formed, slightly divergent spinous carinae. The spinules are fewer than nine on each carina; they increase in size posteriorly on each carina, the last one projecting beyond the scale margin. The ridges of the head are rendered quite rough by scales armed with several carinae. Six or seven scales cover the ethmoid, and 9 to 11 the preorbital portion of the infraorbital ridge. The dorsoterminal plate is of variable length and breadth, and is nearly smooth medially; the ventroterminal plate is rough with conic spines.

The median rostral ridge is covered by seven to nine oblong-elliptical scales, on which the carinae radiate in all directions from a point near the center of the anterior scales, but from a point near the front margin of the posterior ones. The inner oblique group of carinae are obsolescent on those scales which form the series bounding the median rostral series. The character of the squamation between the occipital ridges in diagnostic of the species: from the end of the median rostral ridge backward for a distance equal to the vertical diameter of the orbit, the scales are similar to those of the body, but are rather smaller, and are arranged in five irregular rows; behind these there abruptly follows an area in which the scales are much reduced in size and armature; this area is followed by a cres-

cent-shaped naked region, with the convex side just in front of the occipital scute. This scute is less modified than in related species; it bears five to seven carinae not much stronger than those on the scales of the body; behind this scute the scales are rather small; a similar scute, even less modified, occurs in some specimens on the mid-dorsal line between the main scute and the origin of the first dorsal; a scute with a strong median keel is sometimes developed at the anterior end of the lateral line. The squamation of the region between the occipital and postorbital ridges also differs conspicuously from that of the other species: the lower two-thirds of this area is covered by two or three subequal rows of scales, bearing as many as 11 divergent carinae, while the upper third is covered by scales mostly of greatly reduced size. The region below the orbit and the larger part of the anterolateral region of the upper surface of the snout are covered by prickle-like scales. The under side of the head is wholly naked.

The first dorsal spine is sharp; the second spine in some specimens ends in a short, fine filament; its length is variable, about equal to the postrostral length of the head. The base of the first dorsal is contained 1.3 to 1.7 times in the interdorsal space, and 1.4 to 1.8 times in the postorbital length of head. The second dorsal fin is low anteriorly, its first rays being contained from 4 to 6 times in the length of the orbit. The origin of the anal fin lies below the middle or the anterior half of the interdorsal space. The outer ventral ray ends in a filament, which, like that of the dorsal spine, is sometimes compressed distally. The second ventral ray reaches almost to the origin of the anal fin. The wide variation existing in the length of the fin-rays is apparently not sexual, as was demonstrated in those species with elevated dorsals (as *C. velifer*).

Table to show variation of fin-rays in male and female specimens.[1]

	Males.	Females.
Second dorsal spine in head	1.5 to 1.85	1.6 to 2.0
Third dorsal ray in head	1.7 to 1.9	1.8 to 2.2.
Pectoral fin in head	2.2 to 2.5	2.1 to 2.65.
Outer ventral ray in head	2.1 to 2.8	2.25 to 2.7.
Second ventral ray in head	3.45 to 4.0	3.4 to 4.25.

[1] Five males and four females were measured, including both sexes from southern Luzon and from off Jolo Island.

The color of *C. argus* is more variable than that of any other species of the group examined. The ground color varies from light yellowish to dark brown. The region between the anus, ventrals, and isthmus is blackish. The dark specimens are from China Sea, while the lighter ones were dredged in the vicinity of Jolo Island, and in Davao Gulf, off the southern coast of Mindanao (other differences are not evident between the northern and the southern specimens). The dark markings are very indistinct in certain specimens, both of the light and dark types, while in others they are very

strongly marked. The spot behind and above the pectoral fin covers seven to nine oblique rows of scales, and extends upward to include one or two rows above the lateral line. This spot in some specimens, most notably in the young, is ocellated by a white ring, which separates the spot from the dark squarish blotches extending forward and backward from the first dorsal fin. After an interspace about as long as the snout plus the orbit, the pectoral spot is followed by a dark bar extending from the dorsal downward and backward to the anal, and covering five to seven rows of scales. The sides of the head and body show silvery reflections. The branchiostegal membranes are mainly dark, but are margined with whitish. The linings of the buccal cavity, except about the mouth, and of the upper half of the branchial cavity, are dusky. The parietal peritoneum is light purplish brown, punctulate with black, and underlain by silvery; the peritoneum is little darkened in young specimens. The color of the fins, like that of the body, is widely variable; the first dorsal is whitish or dusky, with the larger and distal part of its spine, and the smaller and distal portion of its soft rays, blackish; the second dorsal is constantly light, but the anal varies from dusky to blackish anteriorly, and from whitish to dusky posteriorly; the pectoral is whitish or dusky, the ventral dusky or blackish, with the filament of its outer ray whitish.

This species probably never reaches a large size. Our largest specimen among 25 is a male, and measures only 65 mm. to the anus, while females measuring 54 to 64 mm. to the anus have their ovaries filled with ripening ova. *C. argus* is most closely related to *C. dorsalis* from northern Luzon, from which it differs in the larger scales, lower dorsal, narrower snout, and in details in the form and in the squamation of the head.

Table of measurements in hundredths of length to anus.

Albatross station	5549	5549	5135	5112	5549
Total length, in mm	196	186	171	[1] 167	[1] 187	117
Length to anus in mm	64	59	53.5	54	65	35
Length of head	80	87	81	78	81.5	78
Length of orbit	24	21	22	23	23	24
Postorbital length of head	24	23	24.5	25	23	24
Width of interorbital	16	14	16	15.5	16	15
Width of suborbital	10	8.5	9	9	9	9
Orbit to preopercle	28	25	26	28	25	26
Length of snout	33	33.5	34	31	37	33
Length of upper jaw	20.3	18	19	20	18	19.5
Depth of body	46	39	43	42	41	40
Width of body	31	30	32	31	31	28
Anus to anal	11.3	8.5	13	9	10.5	8
Anus to ventral	19	17.5	18	16	17	16
Ventral to isthmus	24	22	24	23	21	22
Height of second dorsal spine	46	52.5	52	49	44	42
Height of third dorsal ray		46	48		42.5	41
Length of first dorsal base	17	15	14	16	14	16
Length of interdorsal space	22	26	22	21	22.5	21
Length of pectoral	36	36	38	36	32	34
Length of outer ventral ray	36	36	38	37	30	36
Length of second ventral ray	20	21	22	21	21	19

[1] A small pseudocaudal developed.

(*argus*, in reference to the eyelike spots.)

31. COELORHYNCHUS MACROLEPIS, new species.

Type-specimen.—Cat. No. 78220, U.S.N.M.; collected by the *Albatross* in 236 fathoms at station 5111 in China Sea off southwestern Luzon. It is 143 mm. long to the end of a large pseudocaudal of 10 rays, and 55.5 mm. to the anus.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5111	China Sea, vicinity of southern Luzon	236		35
5280	do	193	49.6	1
5281	do	201	50.4	1
5365	Balayan Bay, southern Luzon	214		20
Lost				1

This small and fragile species is represented in the collection by 58 specimens, varying in length from 27 to 70 mm. to the anus; 18 females, in which the heads measure from 41 to 52 mm., have ripe or ripening ova. It is one of the most distinct species of the *notatus* group, being distinguished from all of the others by its larger scales, and from those species without a ventral fossa in numerous other characters; the orbit is larger, the snout of different form, and the squamation different in many details.

Fin-rays—first dorsal, II, 9 (8 to 19 in paratypes); pectorals, 17 (or 16); ventrals, 7 (constant).

This is a slender form, with an arched dorsal contour more notably elevated than usual at the origin of the first dorsal fin. The greatest depth is contained 1.8 (to 2.0) times in the head; the width across the bases of the pectoral fins, 2.5 (2.4 to 3.00) times, being a little less than the depth of the body below the origin of the lateral line. In distinction from all other species of the *notatus* group, with the exception of *maculatus* and *velifer*, the dorsal contour of the snout is almost straight. The suborbital and preorbital portions of the infraorbital ridge are straight in outline; the ethmoid region is evenly convex. The width of the snout across its anterolateral angles is greater than the length of the snout before the angle. The dorsoterminal plate varies widely in its length, which is contained from 3.0 to 4.3 times in the postorbital (3.7 times in the type). The subopercle ends below and behind in the usual pointed flap. The interorbital space is wider than in *dorsalis* or *argus*, and the suborbital is markedly broader. The maxillary extends backward a little beyond the vertical from the middle of the orbit. The teeth are villiform on the jaws; the outer premaxillary series is scarcely enlarged; the barbel is short and slender. Six branchiostegals; gill-membranes

with a free fold. The center of the anus is in advance of its normal position before the origin of the anal fin, the interspace being contained 1.4 (1.0 to 2.0) times in the distance between the anus and the base of the outer ventral ray; the latter distance is contained 1.4 (1.3 to 2.0) times in the interval between the ventral fin and the isthmus, or 1.4 (1.3 to 1.8) times in the postorbital length of the head.

Summarized table of proportion of parts of the head.[1]

	Variation.	Type-specimen.
Orbit in head	3.05 to 3.3	3.05
Orbit in postorbital	0.8 to 1.0	0.8
Orbit in snout	1.2 to 1.4	1.25
Interorbital in postorbital	1.3 to 1.5	1.5
Suborbital in postorbital	2.0 to 2.25	2.0
Upper jaw in head	4.1 to 4.65	4.2
Barbel in postorbital	3.6 to 5.5	5.0
Length of snout in head:		
Preocular	2.25 to 2.6	2.5
Preoral	2.4 to 2.9	2.9
Width of snout in head	2.4 to 2.7	2.55
Width of snout at end of ethmoid region of infraorbital ridge, measured into length of snout before that point	0.8 to 1.0	0.85

[1] Measured in each case on 22 specimens, varying in length of head from 30 to 47.5 mm. (excepting case of barbel, measured in 16 specimens). Length of head in type-specimen, 44 mm.

The scales, especially those on the head, are loosely imbricate; they are larger than in any other species of the *notatus* group, there being constantly but 4 or 4½ in a series from the origin of the second dorsal to but excluding the scales of the lateral line. The scales of the body are about as rough as in *argus* or *velifer*, but those on the head, especially along the ridges, bear longer and stronger spinules. On each scale of the body there are from 9 to 11 parallel rows of slender and usually long spinules, the arrangement of which is slightly irregular as a result of the obsolescent character of the ridges along which the spinules are usually borne. The last spinule of each series often projects well beyond the margin of the scale. Six to 8 scales, studded with strong conic spinules, bound the ethmoid region of the infraorbital ridge; there are 8 to 11 scales on the preorbital section of the ridge. There are 8 (6 to 9) scales in a series along the superior rostral ridge; from near the anterior margin of each of these elongate scales there radiate backward several series of fine spinules. This median rostral series is bounded on each side by a single series of rather large scales bearing spinules in several series directed chiefly backward and inward, but not differentiated into two groups as usual in related species. The squamation of the region between the occipital ridges offers diagnostic characters: along the region vertically above the orbit there are three very regular and parallel rows of scales similar to those of the body (in paratypes smaller scales are sometimes interpolated between these series, rendering the arrangement less regular); between the abrupt

termination of these series of scales and the occipital scute there is an area covered by prickles anteriorly but naked posteriorly. The occipital scute, often double or even triple,[1] is armed by a strong median spinous keel and by a few weaker lateral carinae variously developed; no scute is present on the mid-dorsal line between the occipital scute and the dorsal fin, but there is a small scute just above the origin of the lateral line. The median of the 3 irregular series of scales between the occipital and postorbital ridges is enlarged only anteriorly. Except for the presence of a few scales posteriorly, the anterolateral region of the snout is wholly naked. There are no scales on the under side of the head.

The first dorsal spine is stout and very short; the second spine is about as long as the first soft ray, and when unbroken at its tip

FIG. 14.—COELORHYNCHUS MACROLEPIS. TYPE.

is about equal to the postrostral length of the head (often somewhat longer, sometimes slightly shorter). The base of the first dorsal is contained 1.6 (1.25 to 1.6) times in the interdorsal space, and 1.5 (1.3 to 1.6) times in the postorbital. The origin of the anal lies behind the vertical from the middle of the interdorsal space. Length of pectoral, 2.15 (to 2.8) in the head. As in the case of *C. argus*, this wide variation in the length of the fin-rays appears not to be correlated with sex. The outer ventral ray is constantly shorter than in related species except *argus*, being contained 2.4 times in the head in the type and in most of the paratypes of either sex, but varying from 2.25 to 2.6. The short second ventral ray fails to reach the anal, and is contained 3.9 to 4.4 times in the head.

Coloration in alcohol.—The ground color is light, with more or less evident markings as in related forms. The abdomen between the

[1] This degree of variation is apparently characteristic of this species.

anus and the ventral fins is blackish, but the region anterior to the ventrals is usually dark brown (or light brown). The usual roundish spot above and behind the pectoral fin covers about seven oblique scale rows, and is ocellated with a lighter ring, which is preceded by an indistinctly darker squarish saddle just before the first dorsal fin, and followed by a similar saddle extending below the interdorsal space. Silvery reflections are seen on the sides of the head and body. The coloration of the head in general is light, becoming dark brown near the anterolateral angles of the snout, and blackish on the opercle. The buccal cavity is lined with purplish brown, without light margins about the gape; the branchial cavity is lined with brownish black, with a narrow light margin along the free edge of the opercular and branchiostegal membranes. The vertical fins are blackish, varying to light dusky; pectorals, light dusky; ventrals blackish, with a white filament. In the young the first dorsal may be whitish proximally, but black on the tips of the spine and the front rays. The tail of the young is crossed by bars which are wider than the light interspaces between them.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.			
Albatross station	5111	5365	5111	5111	5111
Total length in mm	[1] 143	164	152+	.....	[1] 104
Length to anus in mm	55.5	53	55	53	36
Length of head	80	82	81	82	81
Length of orbit	27	26.5	26	25	26
Postorbital length of head	23	21.5	23	22	22
Width of interorbital	16	17	17	16	16
Width of suborbital	11	11.5	10	11.5	11
Orbit to preopercle	25	26	26	26	27
Length of snout	32	36	35	36	36
Length of upper jaw	19	18	18.5	18.5	19
Depth of body	44	43	43	43	39
Width of body	32	29	31	30	27
Anus to anal	12.5	9	.....	11	8
Anus to ventral	17	14	.....	13	14
Ventral to isthmus	23	22	26	22	23
Height of second dorsal spine	.....	49	48	47	45
Height of third dorsal ray	.....	.....	46	.....	.....
Length of first dorsal base	16	14	16	15	16
Length of interdorsal space	22.5	21.5	26	23	21
Length of pectoral	38	34	39	33	33
Length of outer ventral ray	35	38	34	33	37
Length of second ventral ray	19	23	.....	20	21

[1] A pseudocaudal developed.

(*macrolepis*, in reference to the large scales characteristic of this species.)

32. COELORHYNCHUS CINGULATUS, new species.

Type-specimen.—Cat. No. 78221, U.S.N.M., a male, 136 mm. long to the end of a broken pseudocaudal, 56.5 mm. to the anus (about 0.5 mm. of tip of snout estimated as broken off). The type was dredged by the steamer *Albatross* at station 5317, in the China Sea near Formosa; depth, 230 fathoms; bottom temperature, 50.6° F.

A single paratype was obtained: length, 148 mm. to end of injured pseudocaudal, 60 mm. to anus; *Albatross* station, 5325; locality, China Sea off northern Luzon; depth, 224 fathoms; bottom temperature, 53.2° F; sex, female, with unripe ova in an elongate ovary.

Fin-rays—first dorsal, II, 8 (II, 9 in paratype); pectorals, 17 (18); ventrals, 7.

The dorsal and ventral contours of the slender body are long, even curves; the greatest depth is contained 2.2 times in length of head; the greatest width across pectoral bases is about equal to the depth below origin of lateral line, and is contained 2.8 times in length of head. The dorsal contour of the head above and behind the orbit is gently convex, while that of the snout is concave. The sides

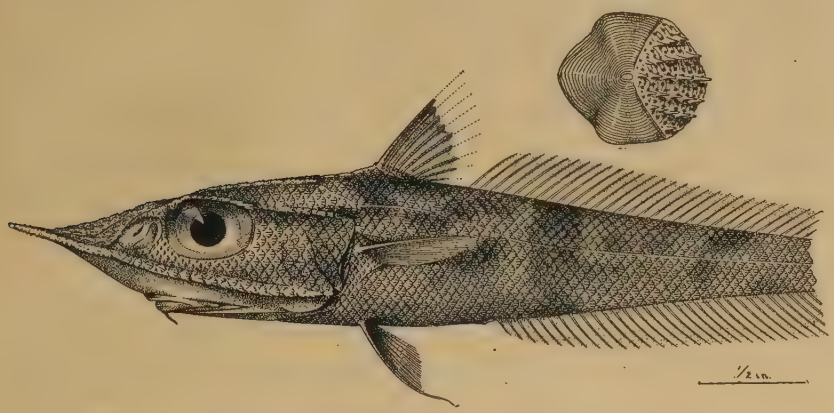

FIG. 15.—COELORHYNCHUS CINGULATUS. TYPE.

of the head are straight medially along the preorbital and suborbital portions of the infraorbital ridge, but the contour of the ethmoid portion of the ridge is doubly curved, being convex posteriorly, and concave anteriorly just behind the sharp, long, and slender terminal spine; the length of the dorsoterminal plate is contained 2.3 times in the postorbital (in paratype). The width of snout at front of orbits is equal to the length of the ethmoid region of the infraorbital ridge, and is contained 2.7 (2.85) times in the head. Preocular length of snout, 2.2 in head; preoral length, 2.4 (2.3). The occipital ridges are subparallel anteriorly, but divergent posteriorly; the least distance between them is contained 1.3 (1.4) times in the distance between their terminations, and is equal to the least suborbital width, each being contained 1.6 to 1.7 times in the interorbital. The postorbital ridge is curved slightly upward anteriorly, slightly downward posteriorly. The lower subopercular angle is produced downward and backward into a long, blunt flap, in contrast with the more slender, pointed flap of the

preceding series of species. The orbit is small: 3.8 (4.1) in the head; 1.75 (1.85) in snout; 1.15 (1.25) in postorbital. The least interorbital width is contained 1.4 (1.5) times in the postorbital; least suborbital width, 2.2 (2.4) times. The upper jaw (4.5 and 4.8 in head) extends just a little beyond the vertical from the hinder margin of the pupil; the teeth of the premaxillary are somewhat enlarged in an outer series. The barbel is short and very slender, 6 (5) in the postorbital; 6 branchiostegals; fold of gill-membrane very narrow.

The anus is located immediately before the anal fin, well behind the vertical from the origin of the second dorsal. Its distance from the base of the outer ventral ray is notably longer than either the distance between the ventral and the isthmus or the postorbital length of the head, and is contained 2.6 times in the head; the distance between the ventral fin and the isthmus is equal to the length of the orbit. The anus is preceded by a small scaleless black area, from which a black line extends forward to the oval ventral fossa, which is covered by very thin, smooth scales, and is located just anterior to the ventral fins; the fossa is one-third as long as the postorbital; the distance from the center of anus to the front of the fossa is half as great as the length of the head. Distance between outer ventral ray and isthmus, 1.25 in postorbital.

Twenty-one pyloric caeca, shorter than the orbit (in paratype).

The scales are well imbricate and of medium size; 5 (or $5\frac{1}{2}$) in a series between the front of the second dorsal base and the lateral line (excluding the lateral line scales). Each scale of the body bears 5 to 7 poorly developed, slightly divergent carinae, which are armed with six (or fewer) spinules near the middle of the scale, where they are strongest and most numerous; these spinules are sharp and slender, and are directed backward; the last ones project beyond the margin of the scale. The spinules on the scales of the head are in general similar to those of the body, but are strengthened moderately on the supraorbital, postorbital, and occipital ridges; those on the snout and on the infraorbital ridge are characteristically small and suberect. The long, sharp dorsoterminal plate is armed by scattered spinules above, and by a marginal series (the strongest) on each side; the ventroterminal plate is armed by five series of spinules; the bases of the terminal plates are bounded by the first two scales of the 9 to 11 which cover the ethmoid region of the infraorbital ridge; the preorbital region of the ridge is covered by 14 to 17 scales in a single series, while the preopercular and suborbital regions, behind the posterior margin of the pupil, are covered by a double series; from this double series there extends forward, between the scales of the ridge and the eye, a diagnostic row of modified scales bearing two strong series of spinules. The median ros-

tral series consists of 9 (6) scales with strongly divergent, but not radiating, series of erect spinules; it is bounded on each side by one or two series of scales, which decrease in size anteriorly, and are armed with six or fewer subparallel series of spinules; these series of scales are separated by a narrow scaleless groove from the lateral regions of the snout, which are covered by small prickly scales. The scales along the occipital ridges bear a median spinous keel and a few lateral carinae, well developed anteriorly, but obsolescent posteriorly; the region between the occipital ridges is covered by 5 irregular rows of scales, which are similar to those of the body posteriorly, but are smaller anteriorly.

The occipital scute, barely apparent, is preceded by a small prickly area; a narrow scute, located just above the origin of the lateral line, bears a strong median spinous crest and one weaker ventral carina. A series of enlarged scales extends forward from the lateral line, each bearing 10 or fewer divergent spinous carinae, of which the median is the strongest; this series is separated from the postorbital ridge by a series of scales like those of the body, and from the occipital ridge by two irregular rows of small scales. The scales on the opercles are like those of the body; those below the orbit are reduced in size.

The under side of the head is wholly naked; the nasal fossa and the concealed portion of the skin over the shoulder girdle are almost completely scaleless.

The interval between the dorsals is very short, only two-thirds the length of the first dorsal base, which is contained 1.8 times in the postorbital. Length of pectoral, 2.7 in the head (in paratype). The length of the filamentous outer ventral ray, which reaches to the origin of the anal, is contained 2.7 (2.65) times into the head; the inner ventral rays, which do not nearly reach the anus, are contained 3.7 times in the head.

The ground color in alcohol is light brown, replaced by silvery white over the entire region of the body cavity, with the exception of a dark bar joining the ventral bases, and crossing the black streak described in connection with the anus and the ventral fossa. The under side of the head is light and punctuate; sides and top of head, grayish brown, shading to darker on the snout, especially toward its anterolateral margins, on the median rostral ridge, and on the anterior and posterior margins of the nasal fossa. Two dark brown streaks radiate backward from the eye, the lower one extending to the angle of the preopercular ridge, while the upper one, more conspicuous, extends horizontally backward, just below the postorbital scaly ridge, to the upper angle of the branchial aperture, where it is continuous with the dusky opercular blotch. The area around the

occipital scute is dark brown; a squarish dark blotch surrounds a small light median patch between the ends of the occipital ridges. The character of the highly variegated markings is similar in the two specimens, and is sufficiently well shown in the figure. The posterior portion of the tail is marked by a series of dorsal and anal blotches, extending from the fin bases almost to the lateral line. The first dorsal and pectoral fins are light dusky; the second dorsal and the anal are light except near their anterior ends; the ventral fin is dark, with a white filament. The buccal cavity is lined with dusky except near the gape; the upper walls of the branchial cavity are brownish black; the opercular and branchiostegal membranes are bordered along their free edge by a light streak; the parietal peritoneum is purplish brown underlain with silvery.

Table of measurements in hundredths of length to anus.

	Type.	Paratype.
Albatross station	5317	5325
Total length in mm	[1] 136	[1] 148
Length to anus in mm	56.5	60
Length of head	72.5	70
Length of orbit	19	15
Postorbital length of head	22	21.5
Width of interorbital	15	14.5
Width of suborbital	10	9
Orbit to preopercle	22	21.5
Length of snout	33	33
Length of upper jaw	17	16
Depth of body	32	.....
Width of body	26	.....
Anus to ventral	28	27
Ventral to isthmus	18	17
Length of first dorsal base	12	12
Length of interdorsal space	8	7
Length of pectoral	.....	27
Length of outer ventral ray	29	26
Length of second ventral ray	18	.....

[1] A pseudocaudal developed.

C. cingulatus is a species not closely related to others found in the same or adjoining waters. It is probably most closely related to *innotabilis*, an Australian species with which it is compared in the preceding key to the species of the genus. It also bears some resemblance to *gladius*, an Hawaiian species.

(*cingulatus*, banded.)

Subgenus OXYMACRURUS Bleeker.

33. COELORHYNCHUS PLATORHYNCHUS Smith and Radcliffe.

Coelorhynchus platorhynchus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 133, text fig. 8, pl. 30, fig. 1.

In order to present a thorough comparison with the two following species, we have prepared a supplementary description of this species, based upon the following material:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5460	East coast of Luzon	565	.....	1
5585	Vicinity Sibuko Bay, Borneo	476	41.1	[1] 1
5657	Gulf of Boni	492	41.3	3
5658	.....do	510	41.2	3

[1] Type.

Type-specimen.—387 mm. in total length; 150 mm. to anus; dredged at *Albatross* station 5585.

Fin-rays[1]—first dorsal, II, 9; pectorals, 18 (to 16); ventrals, 7.

The general form of the body is correctly indicated in the two type figures; the greatest depth of the body, at the posterior end of head, is contained 1.9 (to 2.1) times in the length of head to end of opercular membrane. The greatest width of the body is contained 2.5 (to 3.0) times in the head; the greatest width of the head is equal to its depth through the hind margin of the eye. Preocular length of snout, 2.7 (2.5 to 2.9); preoral length, 3.05 (2.9 to 3.3); width of snout across its base, 2.7 (to 2.5); width of snout at end of ethmoid region of the infraorbital ridge, into the distance from that point to the tip of snout, 0.75 (to 0.8). The occipital ridges diverge rather widely posteriorly; the least distance between them is contained 1.7 (to 2.0) times in interorbital. Length of the orbit: 3.4 (3.35 to 3.6) in head; 1.25 (1.2 to 1.4) in snout; 1.2 (to 1.25) in postorbital. Least interorbital width, 1.6 (1.5 to 1.7) in postorbital; least suborbital width, 2.5 (2.4 to 3.0). Length of upper jaw into head, 3.85 (3.8 to 4.1); the upper jaw extends from below the hind margin of the anterior nostril backward to a vertical passing across the eye between its hind margin and the pupil. Branchiostegal rays, 6; the gill-membranes form a free fold across the isthmus. The free length of the barbel enters 4.9 (4.2 to 5.2) times into the postorbital length of the head. The lower subopercular angle is produced backward as a long narrow flap, which is curved slightly downward distally.

Distance from center of anus to base of outer ventral ray, 2.15 (to 2.9) in head; distance from ventral fin to isthmus, 3.2 (to 3.6); distance from anus to isthmus, 1.3 (to 1.6). The anus is immediately preceded by a naked space about as long as the peritroct; above it, between the muscles of the body wall, there lies a flattened gland-like body which probably represents the structure described in some detail in other species; in color this organ is black below, and dusky above.

Thirty-two pyloric caeca about as long as the orbit were counted in a paratype.

[1] Counted in all eight specimens.

The scales are large, in but 4½ series from the origin of the second dorsal to but excluding the lateral line series; an additional series is inserted shortly behind the origin of the second dorsal. The 5 to 7 widely divergent carinae on each scale of the body are armed with about 6 very strong, broad spinules, imbricate, and increasing in strength posteriorly, the last one often projecting a little beyond the margin of its scale; the spinules of the median series are often much larger than those on the lateral carinae. The scales on the spinous ridges of the head are greatly strengthened. The dorsoterminal and ventroterminal plates are armed by 3 to 5 divergent carinae, and are scarcely produced beyond the lateral contour of the head. There are 7 to 9 scales along the ethmoid portion of the infraorbital ridge on each side; the 9 to 11 scales on the preorbital portion of the ridge are largest below the front margin of the orbit,

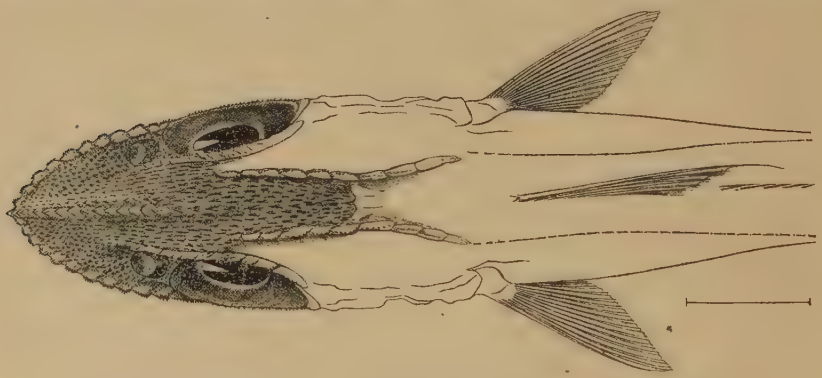

FIG. 16.—COELORHYNCHUS PLATORHYNCHUS. TYPE. AFTER RADCLIFFE.

and bear spinules mostly confined to their lower margins and to a single vertical series; the scales of the suborbital and preopercular portions of the ridge—that is, behind the vertical through the middle of the eye—are arranged in two series; the distance between the end of the infraorbital ridge and the preopercular margin is contained 4 (3.5 to 5) times in the postorbital length. The scales between the orbit and the infraorbital ridge are small; those from the nasal fossa to below the middle of eye are irregular in position and somewhat strengthened, while those below the posterior half of the orbit, and backward to the preopercular ridge, are regularly arranged, and bear mostly a single spinous ridge directed backward and downward. A series of 10 to 12 scales covers the median superior rostral ridge, extending backward to between the verticals from the front of orbit and the front of pupil; each of these quadrate scales is armed by 3 to 7 spinous carinae radiating outward and backward from the middle of its front margin.

The occipital ridges are covered by modified scales in the form of elongate tubercles bearing one or two keels, which are armed by

strong spinules; the median occipital scute is also a strong tubercle, bearing a single spinous keel (three in one specimen); the scute may or may not be preceded on each side by a similar scale, or by a short naked region; from near the front of the scute five rows of scales diverge forward, confined posteriorly between the occipital ridges, but curving outward on the snout to bound the median series; these scales are mostly armed by a single, but sometimes by 2, 3, or even 4 trenchant spinuous keels. The anterolateral region of the snout, within the infraorbital ridge, together with the lower portion of the nasal fossa, is covered by small scales with a single (more rarely several) spinous ridge, the height of which may exceed the length of the scale. The series of scales on the postorbital and the posterior half of the supraorbital ridges are similar to those of the occipital ridges; between the postorbital and occipital ridges the scales are little modified, usually bearing several carinae; those bounding the ridges are reduced in size, while those forming the median series are somewhat enlarged. The scales on the opercles and on the upper half of the cheeks in general are similar to those of the body. The underside of the head, excluding only the lips and the gular and branchiostegal membranes, is wholly covered by small scales, each of which bears a high spiny keel.

In one paratype the outer ventral ray, reaching a little past the origin of the anal, is 0.53 of the length of the head (0.45 in type). Length of the pectoral fin, 2.0 to 2.4 in head.

The color becomes darker on the belly and opercles. The linings of the buccal, branchial, and peritoneal cavities are wholly dark brown, with the exception of an indistinct light margin along the free edge of the opercular and branchiostegal membranes.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.		
Albatross station	5585	5658	5657	5658
Length to anus in mm	150	144	130	122
Length of head	66	68	69	69
Length of orbit	20.5	19	21.5	20.5
Postorbital length of head	23.5	23.5	25	24
Width of interorbital	15	----	17	15.5
Width of suborbital	9.5	8	----	10
Orbit to preopercle	26	25.5	28	27
Length of snout	25	27	24	27
Length of upper jaw	18	18	18	17
Depth of body	35	36	37	35
Width of body	27	23	26	26
Anus to ventral	31.5	30.5	28	26.5
Ventral to isthmus	22	23	22	20.5
Length of first dorsal base	14	13.5	14.5	12

(*platorhynchus*, in reference to the form of the snout.)

34. COELORHYNCHUS ACANTHOLEPIS, new species.

Coelorhynchus platorhynchus form *alpha* RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 134, text fig. 9 (exclusive of the specimen from *Albatross* station 5111).

Coelorhynchus japonicus WEBER, Die Fische der *Siboga*-Expedition, 1913, p. 163 (not *Macrurus japonicus* Temminck and Schlegel).

Type-specimen.—Cat. No. 78222, U.S.N.M.; 316 mm. long, 118 mm. to anus, from *Albatross* station 5587, off Borneo; figured by Radcliffe.[1]

List of paratypes.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Length to anus.
			° *F.*	
5587	Vicinity of Sibuko Bay, Borneo	415	42.3	113
5583	.....do	347	44	59
5586	.....do	347	44	[1] 32

[1] About.

In the following description comparison is made with *C. platorhynchus;* certain details alike in the two species are omitted. After the various measurements and counts of the type, two additional measurements or counts, if different, are given in parentheses: first, of the paratype 113 mm. long to anus; second, of the specimen 59 mm. long to anus; the smallest one, being in poor condition, is not included in the description.

Fin-rays—first dorsal, II, 9; pectorals, 17 (18, 18); ventrals, 7.

The form of the head as seen from above is well figured by Radcliffe (see fig. 17). The depth of the body, 1.8 (1.9, 2.4) in head, is slightly greater below the origin of the first dorsal fin than at any other vertical; greatest width of body, 2.4 (2.3, 2.75). Measurements of snout into head—preocular length, 2.6 (2.55, 2.4); preoral length, 3.05 (2.9, 2.85); width across base of snout, 2.6 (2.6, 2.5); width across snout, at end of ethmoid portion of infraorbital ridge, 0.8 (0.8, 0.85) in length of snout before that point. Least distance between divergent occipital ridges, 1.8 (1.6, 1.85) in interorbital. Length of orbit—into head, 3.4 (3.6, 3.4); into snout, 1.33 (1.35, 1.35); into postorbital, 1.15 (1.15, 1.05). Least interorbital width, 1.5 (1.6, 1.4); least suborbital width, 2.3 (2.25, 2.2). Length of upper jaw, 3.9 (3.9, 4.0); the upper jaw extends from below the anterior nostril to behind the pupil. Length of barbel, 4.8 in postorbital (in largest paratype).

Distance from center of anus to base of outer ventral ray, 2.65 (2.8, 2.7) into head; distance between ventral and isthmus, 3.05 (3.4, 3.4); distance from anus to isthmus, 1.5 (1.7, 1.6).

[1] Proc. U. S. Nat. Mus., vol. 43, p. 134, text fig. 9.

The scales are in 4½ rows between the origin of the second dorsal and the lateral line series; an additional series is inserted shortly behind that point (the first rays of the second dorsal are broken off in the type). The spinules on the body scales are set along 4 to 7 carinae[1]; these spinules are similar to those of *C. platorhynchus*, being strong, but somewhat weaker than in that species. The scales on the front half of the infraorbital ridge often have about three series of spinules directed upward and backward; there are 8 scales on each side of the ethmoid region of the infraorbital ridge, and 9 (8, 8) on the preorbital region, which is bounded above by a smaller but similar series subtending the front half of the orbit; the suborbital and preopercular portions of the ridge are covered by two series of similar scales; the distance between the end of the infraorbital ridge and the preopercular margin is contained 4.6 (4.6, 4.0)

FIG. 17.—COELORHYNCHUS ACANTHOLEPIS. TYPE. AFTER RADCLIFFE ("COELORHYNCHUS PLATORHYNCHUS, FORM ALPHA").

times in the postorbital. The median rostral ridge is covered by 11 (10, 9) subquadrate scales with 5 to 7 carinae radiating from near the front margin of the scale. The scales of the occipital and postorbital series, like those of *C. platorhynchus*, bear but a single keel. The occipital scute has only a median spinous keel; it is preceded in the two larger specimens by a short naked area, but in the smaller paratype by two similar scutes, one on either side. The scales along the supraorbital ridge are armed by numerous close-set spinules. The other scales on top of head are arranged as in *C. platorhynchus*, but are armed with 1 to 7 (usually several) carinae. The scales in the region between the occipital and the infraorbital ridges are in general similar to those on the body, but rather smaller; a median series between the occipital and postorbital ridges is enlarged; the scales on the lower half of the cheeks, downward and backward from the eye, and those between the preopercular and infraorbital ridges, are reduced in size and are usually armed only by a single keel. The anterolateral region of the snout, the nasal

[1] In the two larger specimens; the scales are mostly lost in the smaller two.

fossa, the area between the orbit and the infraorbital ridge, and the underside of the head *are completely naked.*

Length of first dorsal base, 1.6 (1.6, 1.9) in postorbital length of head; length of interdorsal space (1.3, 1.6) in postorbital Length of fin-rays in head—second dorsal spine 2.0+[1](1.7+[1]); pectoral fin, 2.1+[1] (2.0+[1]); length of outer ventral ray, 2.4 (1.75, 2.5); length of inner ventral rays, 3.1 (in largest paratype).

Coloration in alcohol.—Dark brown (as in *platorhynchus*), becoming blackish on the fins, belly, underside of head, and the opercle. The buccal, branchial, and visceral cavities are lined by dark brownish membranes; the light margin along the free edge of the branchiostegal membrane is indistinct. The color is lighter in the young, being grayish on the head.

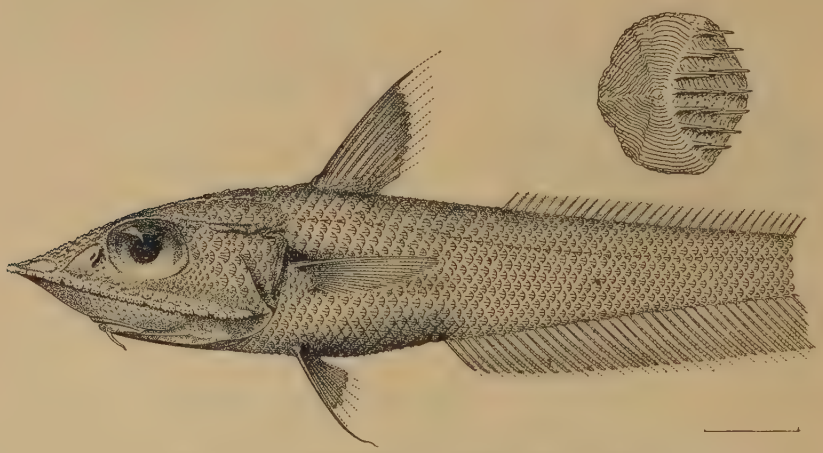

FIG. 18.—COELORHYNCHUS ACANTHOLEPIS. TYPE.

Measurements of type in hundredths of length to anus (113 mm.).—Length of head, 71; length of orbit, 21; postorbital length of head, 24.5; least interorbital width, 16.5; least suborbital width, 10.5; distance between orbit and preopercular margin, 26; preocular length of snout, 28; length of upper jaw, 19; greatest depth of body, 39; greatest width of body (across pectoral bases), 28; distance between center of anus and base of outer ventral ray, 26; distance between ventral and isthmus, 24.5; length of first dorsal base, 15; length of outer ventral ray, 30.

35. COELORHYNCHUS CARINIFER, new species.

Coelorhynchus platorhynchus form *alpha* RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 134 (specimen from *Albatross* station 5111 only, the type of *C. carinifer*).

Type-specimen.—Cat. No. 78223, U.S.N.M.; 332 mm. long to end of broken pseudocaudal, 128 mm. long to anus; dredged at *Alba-*

[1] Indicating a broken tip.

tross station 5111 at a depth of 236 fathoms, in the China Sea off southern Luzon.

Fin-rays—first dorsal, II, 9; pectorals, 16; ventrals, 7.

The form and outline of the body are like those of *C. platorhynchus;* greatest depth, about 1.8 in head; greatest width, across pectoral bases, 2.6; the greatest width of head is about equal to the depth of head at the vertical through the hind margin of the orbit. Preocular length of snout, 2.65 in head; preoral length, 3.5, less than in *C. platorhynchus* or *C. acantholepis;* width of snout across base, 2.6; width of snout at end of ethmoid portion of infraorbital ridge, three-fourths the length of snout before that point. Length of orbit, 3.7 in head, 1.4 in snout, 1.33 in postorbital; the orbit is thus

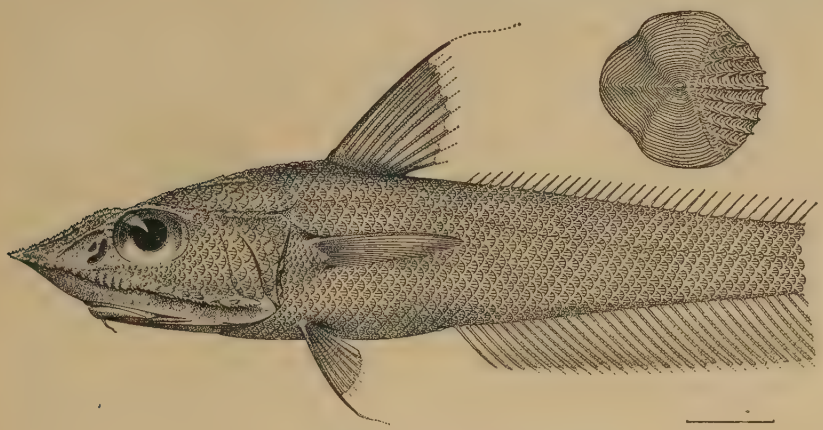

FIG. 19.—COELORHYNCHUS CARINIFER. TYPE.

somewhat smaller than in the two preceding species. The interorbital is markedly wider than in related species; its least width is equal to length of orbit, is contained 1.3 times in postorbital length of head, and contains the least distance between the divergent occipital ridges 2.2 times; least suborbital width, 2.4 in postorbital. The upper jaw is longer and placed farther forward than in *C. platorhynchus* and *C. acantholepis*, being contained 3.55 times in length of head, and extending from before nostrils to just behind the pupil; length of barbel, 4.3 in postorbital. A triangular flap, shorter than in *C. platorhynchus*, extends downward and backward from the lower angle of the subopercle.

Distance from center of anus to base of outer ventral ray, 2.3 in head; distance between ventral and isthmus, 2.8; distance between anus and isthmus, 1.3. A naked space extends forward a short distance from the anus, as in *C. platorhynchus.*

Scales large, in $5\frac{1}{2}$ series between origin of second dorsal and lateral line (exclusive). The scales are not smaller than in *C. plator-*

hynchus and *C. acantholepis*, in which but 4½ series occupy the space between origin of second dorsal and lateral line, the different count being due to the course of the lateral line, which in those two species rises on the trunk to the next horizontal scale row above the one it occupies on the tail. The carinae, numbering 7 to 10 on each scale of the body, are low, divergent ridges, bearing comparatively very weak spinules. The dorsoterminal plate is not prominent and is armed by about 8 rows of spinules; there follows, on the ethmoid portion of the infraorbital ridge, 7 scales on one side, 6 on the other; then 9 (8) greatly strengthened scales with one or a few rows of spinules on the preorbital portion (in a single series); 6 (5) scales, still in a single series, cover the suborbital region of the ridge, and it is only upon the preopercular portion that the scales are in two series; the ridge ends in a sharp point located in front of preopercular margin a distance contained 4.7 (6.0 on right side) times in postorbital. The area between the orbit and the infraorbital ridge is scaled; the portion below the anterior half of orbit with small scales bearing only a few spinules; the portion below posterior half of orbit and extending backward to the preopercular ridge, with scales small but much better developed than in the preceding two species; each one bears 2 to 6 divergent spinous carinae. Nine subquadrate scales, with several carinae directed outward and backward, cover the superior rostral ridge; these scales are bounded by a single series of scales with numerous carinae, outward from which a narrow groove runs forward to the naked anterolateral region of snout, as in *C. acantholepis*. The scales on the occipital ridge are rather weaker than in *C. platorhynchus*, but are otherwise similar; most of them bear a single spinous keel; the postorbital and the posterior half of the supraorbital ridges are covered by scales quite similar to those on the occipital ridges. All of the spinules of the occipital scute but one are arranged along the median keel. The scales between the occipital ridges are armed by three to seven carinae, and are arranged in about five rows. The scales between occipital and postorbital ridges bear numerous carinae; these scales are enlarged in a median series; the scales on the exposed part of opercular bones and on the cheek behind the eye are similar to those on the body. The nasal fossa and the underside of the head are completely naked.

Length of first dorsal base, contained 1.2 times in the interdorsal space and 1.6 times in the postorbital length of head. The first dorsal spine is short, the second almost as long as the postrostral length of head (contained 1.7 times in head); length of pectoral, 1.9 in head; inner ventral rays, 3.6.

Color, brownish, much lighter than in *C. platorhynchus* and *C. acantholepis;* under side of head light brown (instead of blackish), the rami of mandibles, and the gular and branchiostegal membranes,

whitish. The fins are all dusky. The buccal cavity is lined with bluish black, becoming decidedly lighter near mouth; branchial cavity lined with brownish black, except on a narrow but abrupt whitish margin along the opercular and branchiostegal membranes; the peritoneum is dusky-purplish, underlain by silvery.

The lighter color and firmer flesh of this species are characters correlated with the lesser depth probably inhabited by it (as compared with *C. platorhynchus* and *C. acantholepis*). Other distinguishing characters are given in the key to the species.

Measurements in hundredths of length to anus (128 mm.).—Length of head, 67.5; length of orbit, 18; postorbital length of head, 24.5; least interorbital width, 18; least suborbital width, 10.5; distance between orbit and preopercular margin, 27.5; preocular length of snout, 26; length of upper jaw, 19.5; distance from center of anus to base of outer ventral ray, 30.5; distance between ventral and isthmus, 24.5; length of first dorsal base, 15; length of interdorsal space, 17.5; length of second dorsal space, 38; length of pectoral fin, 34.

Only the type is known.

36. COELORHYNCHUS SMITHI, new species.

Coelorhynchus commutabilis SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 192, p. 128 (part).

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom-temperature.	Number of specimens.
			° *F.*	
5122	Off east coast of Mindoro	220		1
5123	....do	283		3
5124	....do	281		2
5198	Near western Bohol	220	53.9	1
5424	Near Cagayan Island, Sulu Sea	340	50.4	2
5503	Vicinity of northern Mindanao	226	53.3	1
5505	....do	220		1
5535	Between Cebu and Siquijor	310	53.3	1
5536	Between Negros and Siquijor	279	53.5	3
5538	....do	256	53.3	1
5590	Near Sibuko Bay, Borneo	310	44.3	1
5621	Between Gillolo and Makyan Islands	298		2

Type-specimen.—Cat. No. 78212, U.S.N.M.,—263 mm. in total length, 102 mm. to anus; dredged at *Albatross* station 5621 on November 28, 1909; 15′ N., 127° 24′ 35″ E.; 298 fathoms.

The specimens vary in length from 37 to 162 mm. to anus.

Fin-rays—first dorsal, II, 9 (8 to 10);[1] pectorals, 17–18 (15 to 19); ventrals, 7.

The greatest depth of body, contained 2.15 (1.8 to 2.3) times in length of the head to the angle of the opercular membrane, is located

[1] The counts and measurements in parentheses are of paratypes.

on the vertical passing through the origin of the first dorsal fin, from which point the contours of the body extend forward and backward in convex curves (more convex in some specimens than in the type, the larger specimens being decidedly more robust than the smaller ones). The ventral contour is gently curved. The greatest width of the body is contained 2.8 (2.4 to 2.9) times in the head; the greatest width of the head is equal to its depth through the hind margin of the orbits, except in very large specimens. The lateral outlines of the head are as figured for specimens of *C. commutabilis* with long snouts.[1] The dorsal contour of the snout is slightly concave. Measurements of snout in head: preocular length, 2.28 (2.05 to 2.4); preoral length, 2.45 (2.25 to 2.9); width of base, at verticals from front of orbits, 3.1 (2.95 to 3.35); width at end of ethmoid portion of infraorbital ridge, 1.25 (1.1 to 1.33) in length of snout anterior to that point. The figures of *C. commutabilis* given by Radcliffe show the course taken by each of the spinous ridges of the head for this species as well; the occipital ridges diverge both anteriorly and posteriorly; the least distance between them is contained 2.05 (1.6 to 1.9) times in the interorbital space. Length of orbit: 3.6 (3.4 to 3.9) in head; 1.6 (1.5 to 1.9) in snout; 1.05 (1.0 to 1.3) in postorbital. Least interorbital width, 1.25 (1.3 to 1.6) in postorbital; least suborbital width, 2.35 (2.33 to 2.6). The upper jaw extends from below the posterior nostril to the vertical passing through the eye behind the pupils (to below the posterior orbital margin in the largest specimen); the length of the upper jaw is contained 4.05 (3.3 to 4.7) times in the head, being decidedly greatest in the largest specimens. Length of barbel, 3.6 (3.6 to 5.6) in postorbital. Six branchiostegals; gill-membranes with a narrow free fold. The lower angle of the subopercle is produced downward and backward into a pointed flap, lying just above the angle of the preopercle.

The distance between the center of the anus and the base of the outer ventral ray is contained 4.0 (3.6 to 5.8) times in the head, 3.0 times in the very large specimens; the distance is only a little shorter than the orbit in the type, but varies from decidedly shorter to about one-third longer than the orbit, being longest in the largest specimens. The distance between the ventral fin and the isthmus is contained 3.75 (2.7 to 4.0) times in the head; the distance from the anus to the isthmus, 2.05 (1.5 to 2.35) times. An oval or linear naked ventral fossa extends forward from the anus for a distance only as long as the peritroct. In the body wall between this fossa and the peritoneum there lies a gland-like body,[2] truncate anteriorly, black on its ventral surface and anterior edge, but silvery dorsally.

[1] Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, text figure 2 (p. 129); reprinted in this report as text figure 27.

[2] Dissected out in a paratype.

Pyloric caeca 21 in two paratypes of medium size, 19 in the largest specimen.

The scales are relatively large, being in $4\frac{1}{2}$ (to 5) rows from the origin of the second dorsal fin to, but excluding, the lateral line series, in $5\frac{1}{2}$ series between the second dorsal and the end of the anterior curve of the lateral line, which is located behind the opercular angle a distance two-thirds as long as the head; behind this point the number of scale rows dorsal to the lateral line again decreases. The scales of the body are armed with from 4 to 6 (3 to 7) strongly spinous carinae, the median one of which is strongest, being armed by about 4 spinules (6 in the largest specimen).

Examined under the microscope, the structure of the scale is seen to be similar to that of other species in the genus. The small focus

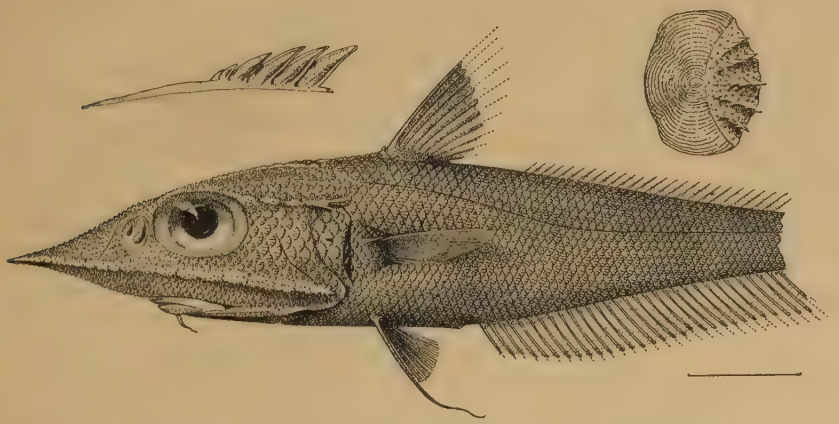

FIG. 20.—COELORHYNCHUS SMITHI. TYPE. UPPER LEFT HAND FIGURE REPRESENTS A LONGITUDINAL SECTION OF SCALE, TO SHOW STRUCTURE OF SPINULES.

is surronded by fine, close-set circuli, which soon give place to coarser circuli, which are evenly spaced to the margin of the scale on all fields; they are parallel with the scale margin on the lateral fields, but may terminate on the basal margin at an obtuse angle, in which case the basal field is divided by a line along which the circuli of each side meet at an acute angle; the circuli on the apical field are perpendicular to lines drawn midway between the carinae. The structure of the spinules is indicated in the figures above. Their anterior and lateral edges appear as ridges, while the surfaces between these ridges are concave. In certain rather definite areas on the tail of a large specimen there occur scales which differ in certain features from normal ones; they are notably thinner, bearing rows of spinules which are more numerous and subparallel instead of divergent; their striae (circuli) are absent except near their margins. These scales are evidently abnormal and in all probability have been re-

generated on an area where the scales had previously been lost by injury. In a former paper the authors described[1] in detail the occurrence, in *Coryphaenoides* (*Nematonurus*) *pectoralis*, of areas of scales bearing an increased number of parallel rows of spinules. On reexamination we find that these scales, too, are thinner than the normal ones and that they lack striae, except near their margins; it is evident, then, that these scales also are regenerated; this explanation accounts for the peculiarly inconstant location of the groups of such scales.

The terminal rostral plate ends in a long, sharply acuminate, spine-like tip, behind which the plate is covered by several long, straight rows of small spinules; the following scales of the infraorbital ridge are closely set with rather strong spinules; these scales are in two series behind middle of eye—that is, on the suborbital and preopercular portions of the ridge; the infraorbital ridge ends sharply a short distance before the preopercular margin, the interspace enterring about 8 (7 to 9) times into the length of the postorbital region of head. The scales below the orbit, in an area extending forward to the nasal fossa and backward to the preopercular ridge, although small, are armed by several series of spinules directed downward and backward. The 8 (to 11) subquadrate scales covering the median superior rostral ridge bear numerous series of spinules radiating from near the center of each; similar scales cover the supranarial and the anterior half of the supraorbital ridges; the posterior half of the supraorbital ridge and the occipital and postorbital ridges are prominent, bearing elongate scales strongly armed by a single (or a few) series of strong spinules directed backward. The scales on the top of the head and on its posterior sides are little reduced in size, bearing several series of high, trenchant spinules; about five series occupy the space between the occipital ridges; a median enlarged series lies between the occipital and postorbital ridges, in advance of the lateral line. The median occipital scute bears 3 (to 5 in large specimens) spinous carinae; it is usually preceded on each side by a similar scute; a scute with a strong median keel is located just above the origin of the lateral line. The scales on the anterolateral region of the snout are small, bear a few trenchant carinae, and are separated by a narrow groove from the series of scales bounding the median rostral series. The lower half of the nasal fossa is scaled. The under side of the head, including the rami of the mandibles, is covered with very small scales, most of which bear a few spinous carinae directed backward.

Length of first dorsal base, 1.7 (to 1.4) in interdorsal space and 1.9 (1.8 to 2.25) in postorbital length of head. Length of fin-rays

[1] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 161–162.

in head—second dorsal spine, 2.6 (2.63 to 2.7); pectoral fin, 2.75 (2.45 to 2.95), not notably shorter in large specimens; outer ventral ray, 2.65 (2.4 to 3.35), varying without apparent relation to the length of the fish; second ventral ray, 5.25 (4.4 to 5.3).

Color, brown, usually darker than in *C. commutabilis;* it is darker above than below; the belly is sometimes dark; opercle with a dark blotch. The young have darker bars on the tail, the first being located below the front of second dorsal, the second being separated from the first by an interspace about as long as the orbit; these markings are very faint in larger specimens. The fins are all dark. The lining of the buccal cavity is bluish black; that of the branchial cavity, brownish black, with an abrupt whitish margin on the opercular and branchiostegal membranes; the parietal peritoneum is dark purplish.

C. smithi is closely related to *C. flabellispinis* (Alcock),[1] known from a specimen dredged by the *Investigator* at a depth of 719 fathoms in the Arabian Sea. Certain differences, however, make the separation of the two imperative, as may be seen from the following table:

	C. flabellispinis.	*C. smithi.*
Spinous carinae on scales	8 or 9	3 to 7.
Pyloric caeca	About 40	19, 20.
Pectorals	Decidedly shorter than postorbital.	Longer than postorbital.
Color of body	Stone-gray	Brown.
Color of peritoneum	Silvery-gray	Purplish-black.
Spines on scales	Judging from figure, much weaker; occasionally the last spine of one rib or more projects beyond the edge of the scale.	Stronger; last spine or carinae usually projects beyond margin of scale.
Barbel	Not much more than half eye	About one-third orbit or less.
Orbit	1.8 in postorbital (measured on Alcock's figure).	1.0 to 1.3 in postorbital.
Double scale row of infraorbital ridge beginning	Behind front of orbit (figure)	Behind middle of orbit.

We are far less certain as to Brauer's[2] *Macrurus* (*Coelorhynchus*) *flabellispinis.* Most of his measurements and counts agree with those of *C. smithi*, and it is not unlikely that his specimens from the west coast of Sumatra are referable to that species. But Brauer has failed, as in other cases, to designate the locality from which his described and measured specimens came. He had other specimens from southern and northeastern Africa.

The relationships of *C. smithi* with *C. commutabilis* are less intimate. *C. smithi* has constantly larger scales; several carinae instead of a median keel on the scales of occipital ridges; browner and

[1] Alcock, Journ. Asiatic Soc. Bengal, vol. 63, pt. 2, 1894, pp. 123, 126; Illustrations of the Zoology of the *Investigator,* pl. 16, figs. 2 and 2*a*; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 107.

[2] Brauer, Die Tiefsee-Fische. 1906, p. 258.

darker color; more strongly curved body contours; a lesser distance between the anus and the base of ventral fin (except in largest specimens), etc.

Table of measurements in hundredths of length to anus.

	Type.	Paratypes.				
Albatross station	5621	5424	5424	5123	5621	5536
Total length in mm	263	----	----	290+	[2] 201	84+
Length to anus in mm	102	[1] 162	151	126	83	37
Length of head	80	72.5	73	77	81	83
Length of orbit	22.5	18.5	19	20	21.5	22
Postorbital length of head	23	24.5	23.5	23.7	21.7	24
Width of interorbital	19	15.5	14.3	16	17.5	18
Width of suborbital	9.5	9.5	9	9.3	9.5	----
Orbit to preopercle	25.5	27	25	26	26	----
Length of snout	36	[1] 30	31.5	33	39	38
Length of upper jaw	19.5	21.7	19.7	20.5	20	18
Depth of body	38	43	ca.40	39	37	----
Width of body	28	29	28	28	30	----
Anus to ventral	19	24	25	21.5	19	15
Ventral to isthmus	23.5	28	25	24	21	----
Height of second dorsal spine	31	----	----	----	30	----
Length of first dorsal base	12.5	----	11.5	11.5	13	----
Length of interdorsal space	20.5	----	----	18	18	----
Length of pectoral	28.5	27.5	25	26	27	26
Length of outer ventral ray	30.5	22	24	20	30.5	----
Length of second ventral ray	16	16	14	----	15	----

[1] Approximate, owing to broken tip of snout. [2] To end of large pseudocaudal.

(*smithi*, named in honor of Dr. Hugh M. Smith, United States Commissioner of Fisheries.)

37. COELORHYNCHUS RADCLIFFEI, new species.

Coelorhynchus commutabilis form *beta* SMITH and RADCLIFFE (the type of form *beta* is chosen as the type of *radcliffei*), Proc. U. S. Nat. Mus., vol. 43, 1912, p. 131, text fig. 4.

Coelorhynchus commutabilis form *gamma* SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 131, text fig. 5.

List of stations.

Albatross station.	"Form."	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
				°F.	
5122	*beta*	Off eastern Mindoro	220	----	1
5221	*beta*	Between Marinduque and Luzon	193	52.4	1
5260	----	Off southeastern Mindoro	234	51.4	1
5374	----	Near Marinduque Island	190	----	2
5502 [1]	*gamma*	Off northern Mindanao	214	----	[1] 2
5503 [2]	*beta*	....do	226	53.3	[2] Type.
5505	*gamma*	....do	220	----	1
5535	*beta*	Between Cebu and Siquijor	310	53.3	1
5536	*beta*, *gamma*	Between Negros and Siquijor	279	53.5	2
5537	----	Between Negros and Siquijor	254	53.5	1
5621	----	Between Gillolo and Makyan Islands	288	----	1
5626	*beta*	Between Gillolo and Kayoa Islands	265	----	1

[1] One of these specimens is the type of form *gamma*. [2] This specimen also the type of form *beta*.

Type-specimen.—Cat. No. 78224, U.S.N.M., 268 mm. in total length; 101 mm. to anus; from *Albatross* station 5503.

The form called *gamma* was apparently distinguished from *beta* by its shorter, blunter snout. In the three specimens of *gamma* other than the type this difference is to be accounted for chiefly by the fact that the terminal spine has been broken off. We are not sure that the tip of the snout is broken in the type of *gamma*, which is the largest specimen known; it may be that the snout becomes blunter in very old individuals, or perhaps the spine in that specimen had been broken off and had since healed over. The measurements are taken on this specimen with the assumption that the tip has not been broken off, and when different from others are given separately.

The following description is based upon all of the specimens which vary in length to anus from 46.5 to 134.5 mm.; those characters which vary with age are so noted.

Fin-rays—first dorsal, II, 8 (rarely 7, sometimes 9); pectorals, 17 (15 to 18); ventrals, 7.

This species resembles *C. smithi* in its arched contours; the snout is slightly concave along its dorsal margin; the base of the first dorsal fin is oblique; the greatest depth of the body lies below the origin of the first dorsal fin, and is contained 2.0 (1.9 to 2.3; 2.6 in young) times in the length of head; the greatest width across the pectoral bases, 2.7 times (2.5 to 2.7; much narrower in young, 4.0).

The snout is much longer in the young than in very large specimens, as indicated in the figures and in the following:

Table showing variation of length of snout[1] with size.

	Paratypes.					Type.	Paratypes.				
Length to anus in mm. (approximate in some).	46.5	89	92	95	98	101	102	104	104	123	134.5
Preocular length	2.1	2.25	2.35	2.5	2.6	2.4	2.5	2.4	2.5	2.7	2.75
Preoral length	2.35	2.6	3.0	3.1	3.3	3.1	3.35	3.1	.....	3.5	4.1
Width at base	3.2	2.95	3.1	3.1	3.2	3.25	2.85	3.15	.....	3.2	3.05
Width at anterolateral angles in length anterior thereto	1.3	1.2	1.2	1.2	1.0	1.2	1.0	1.2	1.05	1.0	0.85

[1] Parts measured into head, except width at anterolateral angles.

The form of the snout as seen from above is indicated by text figures 23 and 24. The same figures also show the courses of the strong spinous ridges of the head; the least distance between the occipital ridges, which diverge a little in both directions, is contained 1.95 times (to 2.1, 1.8 times in specimen 46.5 mm. long to anus) in the postorbital length of the head. The subopercular flap is rather obtusely pointed; its lower margin is nearly horizontal. The orbit is

large, as in *C. smithi* and other species, being contained 3.7 (3.4 to 3.75) times in the length of head, 1.4 (1.2 to 1.7) times in the snout, 1.2 (1.05 to 1.25) times in the postorbital. Least interorbital width, 1.45 (1.35 to 1.55) in postorbital; least suborbital width, 2.65 (2.5 to

FIG. 21.—COELORHYNCHUS RADCLIFFEI. PARATYPE. ADULT.

2.85). The size of the mouth is proportionately much greater in large specimens; the upper jaw extends backward from below (or in front of) the anterior nostril to below the hind margin of the pupil in the smallest specimens, but to below the hind margin of the orbit in the largest; its length is contained in the head from 4.4 times in

FIG. 22.—COELORHYNCHUS RADCLIFFEI. PARATYPE. YOUNG.

the smallest, to 3.3 times in the largest, specimens; 3.8 times in the type, from 3.55 to 3.8 times in specimens from 90 to 110 mm. long to anus. Length of barbel, 3.4 (to 4.7) in postorbital. The teeth are villiform on the jaws. Six branchiostegals; gill-membranes with a very narrow free fold.

The anus is located immediately before the origin of the anal fin; its distance from the base of the outer ventral ray is less than the distance between the ventral fin and the isthmus, and is equal to, or less than, the length of the orbit, being contained 3.7 (3.4 to 4.65) times in the length of the head; distance between ventral fin and isthmus, 3.1 (2.7 to 4.0); distance between anus and isthmus, 1.85

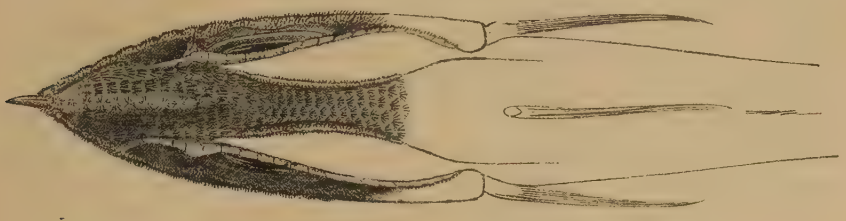

FIG. 23.—COELORHYNCHUS RADCLIFFEI. TYPE. AFTER RADCLIFFE ("COELORHYNCHUS COMMUTABILIS, FORM BETA").

(1.65 to 2.4). As in the foregoing species of the subgenus *Oxymacrurus*, the anus is preceded by a short naked area, which lies just below the gland-like organ in the body wall.

Pyloric caeca, 39 (in one paratype), shorter than the orbit.

Scales large, in but 4½ (or 4) rows from the origin of the second dorsal fin to but excluding the lateral line series. The numerous carinae, bearing many comparatively weak spinules, are highly diagnostic of the species. There are from 6 to 11 carinae on the scales

FIG. 24.—COELORHYNCHUS RADCLIFFEI. PARATYPE. AFTER RADCLIFFE ("COELORHYNCHUS COMMUTABILIS, FROM GAMMA").

of specimens more than 95 mm. long to anus, and from 5 to 8 in smaller specimens. The short and slender spinules lack the prominent ridges and concave surfaces as described for *C. smithi;* the spinules, furthermore, are more numerous than in that species, there being about 8 on each carina, as many as 6 in the specimen only 46.5 mm. long to the anus (7 is the largest number of spinules in any series in the *adult* of *C. smithi*). The terminal rostral plates are each armed by about four long rows of spinules, which become

obsolete distally; the bases of the plates are bounded on each side by one or two scales. The infraorbital ridge is covered by two series of scales behind the middle of orbit. The ridges of the head are covered by rather strong scales, mostly close-set with spinules; the occipital and postorbital ridges, together with the posterior half of the supraorbital ridge, are covered by strong scales bearing a few spinous keels directed backward; the scales on the median rostral ridge are oval or subquadrate in outline, and are armed by several series of spinules radiating in all directions from near the *center* of each scale. The occipital scute is provided with a strong median keel, and with two (one to several) carinae on each side; the median scute is preceded on each side by a weaker one; a similar scute is located just above the origin of the lateral line. The three to five rows of scales covering the region between the occipital ridges are armed by several high, divergent, serrated ridges. The supranarial and medial rostral ridge scales are each bounded by scales in single series, separated from each other by a narrow groove; this groove widens forward and merges into a rather wide anterolateral groove, which, though parallel with the infraorbital ridge, is separated from it by a series of prickly scales; this naked area in the young occupies most of the anterolateral region of the snout, but in the largest specimens is reduced to a narrow groove. Below the orbit and in areas extending backward thence to the preopercular ridge, and forward to the nasal fossa, the scales are reduced in size and spination; the scales between the occipital and infraorbital ridges are otherwise similar to those of the body; the median of the three main series of scales between the occipital and postorbital ridges is slightly enlarged. The nasal fossa and the underside of the head are completely naked in all specimens.

Base of first dorsal, 1.9 (1.3 to 2.2) in interdorsal space, about half postorbital length of the head; the second dorsal fin is weak anteriorly. The outer ventral ray is filamentous; it enters 2.85 (2.4 to 3.2) times into the head; the second ventral ray extends to the anus. The anal fin is inserted a little in advance of the second dorsal.

Color in alcohol, light brown, with silvery reflections on the lower sides; the head is lighter in general, but dusky on the opercles. Other specimens are very pale brownish on the trunk and tail and whitish on the head. The second dorsal fin is light; the filament of the outer ventral ray is whitish; the other fins are dusky, quite light in the more faintly colored specimens. The lining of the buccal cavity is dark, becoming lighter toward the gape in some specimens; that of the branchial cavity is blackish, with an abrupt whitish margin along the opercular and branchiostegal membranes; the parietal peritoneum is purplish or brownish black.

C. radcliffei is apparently related, on the one hand, to *C. smithi* and *flabellispinis*, and, on the other hand, to *productus*, *anatirostris*, and *weberi*. In addition to the characters given in the key, *radcliffei* differs from *productus* and *weberi* in the naked nasal fossa. Its relationships with *commutabilis* are more remote.

Table of measurements in hundredths of length to anus.

Albatross station	5502	[1] 5505	[2] 5503	5536	[4] 5537
Total length in mm.	347	[3] 253	268	.....	137
Length to anus in mm.	134.5	[3] 102	101	95	46.5
Length of head	72	[2] 76	77.5	76.5	81
Length of orbit	22	22.3	22	22	22
Postorbital length of head	26.5	26	25.5	25	22.5
Width of interorbital	17.5	17	17	16.5	16
Width of suborbital	9.7	10.5	9	10	9
Orbit to preopercle	30.5	[2] 29	27	27	26
Length of snout	27	31	32	31	39
Length of upper jaw	23	22	21	20	18
Depth of body	38	40	39	34	32
Width of body	30	29	29	30	22
Anus to ventral	22	20.5	20	20	16
Ventral to isthmus	27	27.5	26	25.5	.....
Height of second dorsal spine	.....	33	33	34	.....
Length of first dorsal base	14	14	13	12	11
Length of interdorsal space	.....	18	25	22	16
Length of pectoral	28.5	34.6	30.5	30	.....
Length of outer ventral ray	24.5	30	27	27.5	34
Length of second ventral ray	17	20.5	18.5	19	.....

[1] See fig.
[2] Type.
[3] Two mm. added as an estimate of the length of spine broken from tip of snout.
[4] See fig.

(*radcliffei*, named for Mr. Lewis Radcliffe, scientific assistant, United States Bureau of Fisheries, in recognition of his work on Philippine Macrouroids).

38. COELORHYNCHUS WEBERI, new species

Coelorhynchus commutabilis form *eta* SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 132, text figure 7 (including only the type-specimen, which is figured; the two other specimens are typical of *C. commutabilis*, the scales having been lost from underside of head).

Type-specimen.—Cat. No. 78225 U.S.N.M.; from *Albatross* station 5325, off northern Luzon, at a depth of 224 fathoms and a bottom temperature of 53.2° F.; length, 315 mm. to end of pseudocaudal of 8 rays, 127 mm. to anus.

Fin-rays—first dorsal, II, 8; pectorals, 18, ventrals, 7.

The contours of the body are long, even curves; the base of the first dorsal is scarcely oblique. The greatest depth of the head is equal to its width; the greatest depth of the body is contained about 2.3 times in the length of the head to the opercular angle; the greatest width, scarcely less, is contained 2.4 times in head; the tail is less strongly compressed than usual, its width being contained just twice in its depth at a point twice the head length behind tip of snout. The form of the head is well shown in figure 25, except that the posterior sides of the head are drawn as somewhat distended. The snout

is very broad, and by maintaining its width forward more strikingly than usually, renders the sides of the snout much more convex distally than in other species with a similarly long snout; its preocular length is contained 2.25 times in head; its preoral length, 2.6 times; its width at base, 2.75 times in head, 1.2 times in preocular length; the width of snout at the end of the ethmoid region of the infraorbital ridge is equal to the length of snout anterior to that point. The ridges of the head are prominent; the occipital ridges are but little divergent forward and backward; the least distance between them is contained 1.2 times in the distance between either their anterior or posterior ends, and is just half the least interorbital width. The preopercular margin is denticulate; the subopercle is produced backward into a sharply pointed flap. The orbit is smaller than usual in this group, its length being contained 4.25 times in head, 1.9 times in snout, 1.35 times in postorbital. Least interorbital width,

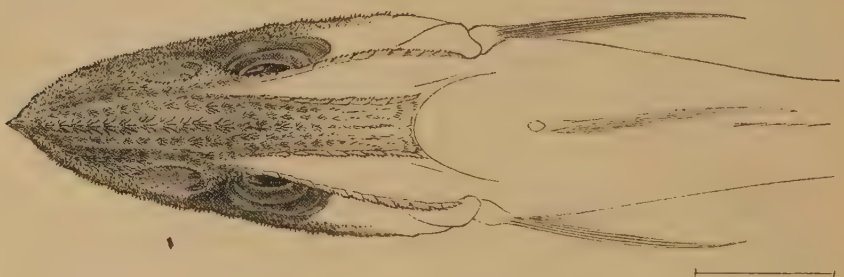

FIG. 25.—COELORHYNCHUS WEBERI. TYPE. AFTER RADCLIFFE ("COELORHYNCHUS COMMUTABILIS, FORM ETA").

1.45 in postorbital; least suborbital width, 2.35. The upper jaw extends from below the middle of anterior nostril backward to below the hind margin of orbit; its length is contained 4.05 times in the head; barbel, 4.2 in postorbital. Teeth villiform, in bands on jaws. Six branchiostegals; gill-membranes with a narrow free fold across isthmus.

Distance from anus to base of outer ventral ray, two-fifths longer than orbit, contained 3.0 times in length of head; distance between ventral and isthmus, nearly one-third longer than orbit, contained 3.35 times in length of head; distance between anus and isthmus, 1.62 in head.

Scales large: in $4\frac{1}{2}$ series between the lateral line and the origin of the second dorsal (excluding the lateral line series), in $5\frac{1}{2}$ series a short distance behind that point; the number then decreases posteriorly. Each scale of the body is well armed by from 5 to 7 strongly spinous carinae. The spinules are long and strong, but not grooved and widened basally as in *C. smithi* (fig. 20); their number is 5 to 7 on the median carina, which is slightly stronger

than the lateral ones; the spinules increase in strength and height posteriorly and are imbricate upon one another; the last one scarcely projects beyond the margin of the scale. The terminal rostral plates do not project strongly; they are rather bluntly pointed, and the series of spinules (6 dorsal, 4 ventral), by which they are armed, are extended forward to their tips; the length of the dorsoterminal plate is contained 4.6 times in the postorbital length of head; the plates are bounded on each side by an elongate scale, the first of the eight covering the ethmoid region of the infraorbital ridge on each side; these scales of the ethmoid region increase in size posteriorly, and bear 6 or fewer strong carinae directed upward and backward; 9 scales, similarly armed, follow on the preorbital portion of the ridge, which then becomes covered by a double series of scales on the

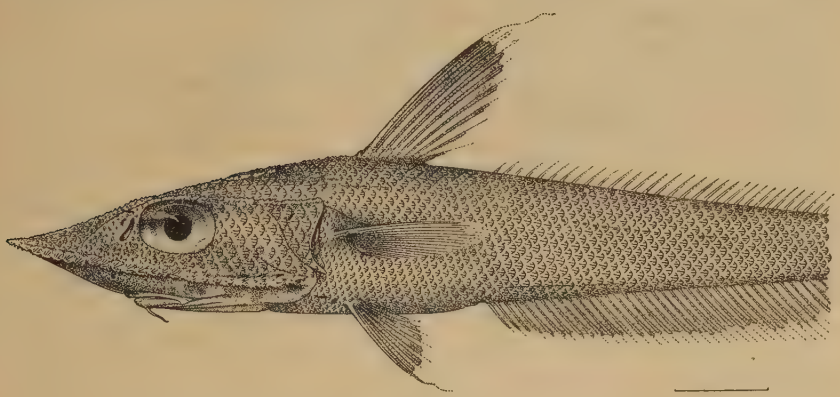

FIG. 26.—COELORHYNCHUS WEBERI. TYPE.

suborbital and preopercular portions, behind the vertical from the middle of eye.

The median superior rostral ridge is covered by 10 shield-shaped scales bearing at most 8 spinous ridges diverging backward and outward from the front of each; this median series is bounded on each side by a single row of well-armed scales; a series of smaller scales bounds the supranarial ridge scales, but the entire remaining anterolateral region of the snout is completely covered by small, crowded scales, like those covering the lower half of the nasal fossa and the region below the orbit extending backward to the preopercular ridge. The anterior half of the area between the occipital ridges is covered by five series of scales which decrease in size posteriorly and converge toward the median occipital scute, which, like the smaller scute preceding it on each side, is armed by a strong median keel. The supranarial and antorbital ridges, and the anterior half of the supraorbital ridge, are covered by scales bearing several divergent spinous crests; the occipital, posterior half of supraorbital, and

postorbital ridges, bear scales armed wholly or for the most part by a single strong spinous keel; a similar scale forms a detached scute at the origin of the lateral line. The scales on the opercles and on the upper half of the cheeks are similar to those on the body; the median series between the occipital and postorbital ridges is much enlarged. The under side of the head is completely naked, with the exception of a few scales below the preopercular angle, as described also for *C. anatirostris*, and as now noted by us in paratypes of *C. productus;* this detail of similarity confirms the other characters which indicate the close relationship between the three species.

The first dorsal fin is high, the second spine being almost as long as the postrostral length of head; the first soft rays are a little shorter; the base of the first dorsal is contained 1.4 times in the interdorsal space, 1.8 times in the postorbital length of head; the first rays of the second dorsal are shorter than the pupil. The pectoral fin is decidedly longer than the postorbital length of head, and is contained 2.2 times in the head (tips of rays broken off). The outer ventral ray is filamentous, being about as long as the pectoral, and extending about to the anal fin; the second ventral ray does not reach to the anus, and is contained 4.0 times in the head.

Color brownish in alcohol, becoming lighter ventrally. Fins dusky, excepting the filament of the first ventral ray. Mouth dusky within, becoming lighter toward the lips. The buccal cavity is lined with brownish black except along the whitish margin of the opercular and branchiostegal membranes; the parietal peritoneum is brownish black.

C. weberi is closely related to two Japanese species,[1] *C. anatirostris* and *C. productus*, but is distinguished by the much smaller orbit, and by the longer, broader snout; by the armature of the scales, there being more carinae than in *C. productus*, but fewer than in *C. anatirostris*, and by a few other details.

Table of measurements in hundredths of length to anus (127 mm.).—Length of head, 70; length of orbit, 17; postorbital length of head, 22.5; least width of interorbital, 15; least suborbital width, 9.5; distance from orbit to preopercular margin, 24.5; length of snout, 31; width of snout, 25.5; length of the upper jaw, 17; length of barbel, 5.5; greatest depth of body, 30; greatest width, across bases of pectorals, 28; distance from center of anus to base of outer ventral ray, 23.5; distance between ventral fin and isthmus, 21.5; height of second dorsal base, 12.5; interdorsal length, 17.5; length of second ventral ray, 17.5.

(*weberi*, named for Dr. Max Weber, in recognition of his work on the fishes of this and other families in the East Indian region.)

[1] See Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 175.

39. COELORHYNCHUS COMMUTABILIS Smith and Radcliffe.

Coelorhynchus commutabilis typical form SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 128, text fig. 2 (part).

Coelorhynchus commutabilis form *alpha* SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 13, 1912, p. 130, text fig. 3.

Coelorhynchus commutabilis form *delta* SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 132, text fig. 6.

Coelorhynchus commutabilis form *eta* SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 132, text fig. 7 (two specimens, exclusive of type).

After having described *C. commutabilis*, Radcliffe proceeded to define certain "forms," differing from the typical specimens in the presence or absence of scales on the underside of the head, and in the form and proportions of the snout and orbit. The discovery of certain diagnostic characters, such as those we emphasize in the analytical key to the species, has led us to a different grouping of these variants. In order to indicate the relation between these "forms" of Smith and Radcliffe and the species, as we define them, the following comparative table has been prepared:

Identification by Smith and Radcliffe.	Present reference.
Coelorhynchus commutabilis:	
Typical form	*C. commutabilis.* *C. smithi.*
Form *alpha*	*C. commutabilis.*
Form *beta*	*C. radcliffei.*
Form *gamma*	*C. radcliffei.*
Form *delta*	*C. commutabilis.*
Form *eta*	*C. weberi.* *C. commutabilis.*

The statement that mutation has been demonstrated in this case[1] therefore appears to lose its significance.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.	Identification by Smith and Radcliffe.
			°F.		
5172	Vicinity of Jolo Island	318		1	Type, *delta.*
5348	Palawan Passage	375	56.4	1	Type, *commutabilis.*
5444	Off eastern Luzon	308	45.3	1	Form *eta.*
5445	do	383	44.3	1	Do.
5589	Near Sibuko Bay, Borneo	260	45.7	1	Type, *alpha.*
5589	do	260	45.7	4	Form *alpha.*
5590	do	310	44.3	1	Do.
5590	do	310	44.3	2	*Commutabilis.*

This species, as we recognize it, is now redescribed in some detail. The description is based upon the type-specimen, 129 mm. long to anus, and is supplemented and verified in all points by an examination of each of the other 11 specimens.

[1] See Radcliffe, p. 130.

The dorsal and ventral contours are long, even curves; the base of the first dorsal is scarcely oblique; the dorsal contour of the snout is but little (or scarcely) concave. Greatest depth of body, 2.2 (1.8 to 2.3) in length of head to end of membrane at angle of opercle; the greatest width of the body or head is about equal to the depth below the origin of the lateral line, and about equal to the depth of the head at the vertical passing through the hind margin of the orbit. The form of the head and trunk is shown in figure 27, in which the width of the body is abnormally contracted, owing to the imperfect preservation of the type-specimen. The length of the snout is unusually variable in this species, so variable that Smith and Radcliffe separated out the short-snouted specimens as a distinct "form," *alpha* (figure 29). That two distinct groups are not represented may readily be seen by an examination of the following table:

Table of measurements of snout in C. commutabilis.

Form	*Eta.*	*Typical.*			*Delta.*	*Alpha.*				
Station	5445[1]	5348[1]	5590	5590	5172[1]	5590	5589[1]	5589	5589	5589
Text figure	.....	27	.....	.....	28	.....	29	.....	.....	.....
Preocular length[2]	2.33	2.35	2.4	2.55	2.5	2.6	2.65	2.62	2.7	2.67
Preoral length[2]	2.6	2.75	2.75	3.2	2.9	3.0	3.1	3.1	3.0	3.1
Width at base[2]	3.15	3.25	3.1	3.1	2.75	2.95	2.95	2.8	3.0	2.9
Width at anterolateral angles[3]	1.1	1.2	1.15	1.0	0.9	0.95	0.85	.09	.09	1.0
Orbit in snout	1.6	1.6	1.65	1.6	1.4	1.35	1.35	1.35	1.26	1.3

[1] Type-specimen.
[2] Measured into length of head.
[3] Measured at end of ethmoid portion of infraorbital ridge, into length anterior to that point.

The ridges of the head are covered by a single series of strong scales, excepting the infraorbital ridge behind the middle of the eye, where the scales are in two series. The occipital ridges diverge a little toward both ends; the least distance between them is contained 2.2 (1.8 to 2.2) times in the interorbital width. The rounded margin of the preopercle is scarcely denticulate; the lower ventral angle of the subopercle is produced backward into a slender flap. The orbit is large, as usual in this group of species, but widely variable in size, being contained 3.9 (3.33 to 3.95) times in entire length of head and 1.25 (1.15 to 1.3) times in postorbital length of head. The variation in the size of the orbit is not correlated with the size of the specimens; the extremes are joined together by intermediate sizes. Least interorbital width, 1.38 (1.33 to 1.6) in postorbital length of head; least suborbital width, 2.9 (2.2 to 2.8). The upper jaw extends backward from below the anterior nostril (or immediately behind that vertical) almost (or quite) to below the hind margin of the orbit; the length of the upper jaw is contained 3.75 (3.35 to 4.0) times in the head; barbel, 3.6 (3.5 to 6.0) in postorbital. Six branchiostegals; gill-membranes with a free fold across the isthmus.

Distance between center of anus and base of outer ventral ray decidedly longer than orbit, a little longer than postorbital, and contained 3.0 (2.4 to 3.0) times in length of head; distance between ventral and isthmus, also longer than the orbit, contained 3.25 (2.8 to 3.4) times in head; distance between anus and isthmus, 1.6 (1.5 to 1.65). A narrow, naked fossa, which extends forward a short distance from the peritroct, covers an elongate glandular organ.

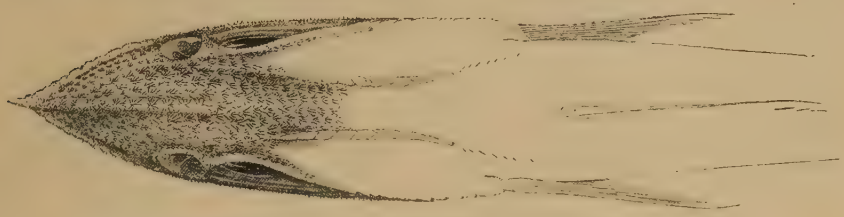

FIG. 27.—COELORHYNCHUS COMMUTABILIS. TYPE. AFTER RADCLIFFE.

Scales rather small, in $5\frac{1}{2}$ rows from the front of the second dorsal fin to but excluding the lateral line series; in 6 or $6\frac{1}{2}$ rows just behind the long anterior curve of the lateral line. The scales of the body bear usually 5, but varying from 3 to 7, carinae, which are armed by a series of spinules overlapping the margin of the scale; the median series is often enlarged. The spinules increase in size posteriorly on each carina, and are rather broad at their base, approaching in their structure those described and figured for *C.*

FIG. 28.—COELORHYNCHUS COMMUTABILIS. AFTER RADCLIFFE ("COELORHYNCHUS COMMUTABILIS, FORM DELTA").

smithi (fig. 19). The terminal rostral plates vary greatly in their length, strength, and spination. The occipital and postorbital ridges are covered by scales armed chiefly by a single spinous keel (by several carinae in *C. smithi*); the scales on the remaining ridges of the head bear numerous spinous carinae; those on the median rostral ridge radiate from near the front of each scale (from near the middle of the scale in *C. radcliffei*). The scales on the top of the head are not greatly reduced in size, and bear several spinous carinae; the scales covering the anterolateral region of the snout,

the lower half of the nasal fossa, and the region below the orbit, extending backward to the preopercular ridge, are reduced in size, but usually bear divergent ridges; the five series of scales between the occipital ridges converge backward toward the median occipital scute, which is variously armed by a single median keel or by several divergent ridges; a somewhat similar scute is located at the origin of the lateral line. The scales between the occipital and postorbital ridges are in about five series, and bear several carinae; those scales forming the median series are markedly enlarged, those in the next series below the median are scarcely reduced, those in the first series above the median are small, those in the two or three other series are reduced in size. In *C. japonicus* the scales of the head are quite different; they are smaller, as a rule, and even in specimens considerably larger than any known of *C. commutabilis* mostly bear only a single spinous crest, except on the scaly ridges

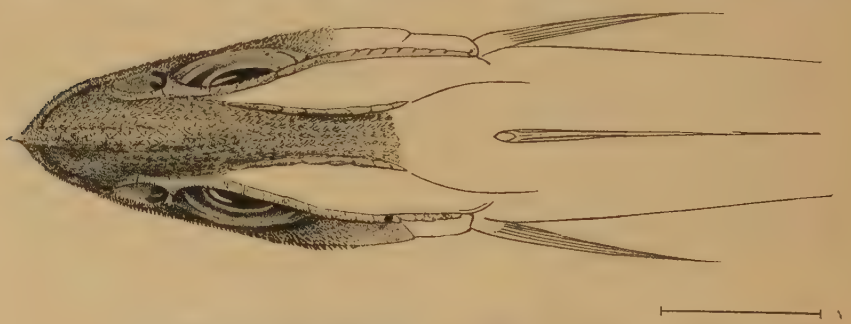

FIG. 29.—COELORHYNCHUS COMMUTABILIS. AFTER RADCLIFFE ("COELORHYNCHUS COMMUTABILIS, FORM ALPHA").

and in the median series between the occipital and postorbital ridges. The underside of the head in both species is constantly covered by small scales.

Pyloric caeca, 20 in one specimen, 28 in another (50 were counted in a specimen of *C. japonicus*).

The height of the second dorsal spine in contained 2.1 (1.85 to 2.1) times in length of head; its length when laid out on the head from the opercular angle extends forward to the front of pupil (in paratypes varying forward and backward from that point a distance almost as great as the diameter of the pupil). The length of the first dorsal base is contained 1.63 (1.35 to 1.75) times in the interval between the dorsals, and 2.1 (1.7 to 2.1) times in the postorbital length of head. The outer ventral ray, ending in a slender filament, is contained 2.65 (2.1 to 3.0) times in head; the second ventral ray, 3.7 to 4.35 times, not reaching to the anus.

Color in alcohol grayish brown, of varying shade, becoming lighter below; darker and less silvery than in *C. radcliffei*, less brownish than in *C. smithi*. The fins are blackish, varying to light

dusky; the outer ventral ray is dark or whitish. The buccal and branchial cavities are wholly lined with bluish black, except along the narrow margin of the opercular and branchiostegal membranes; the parietal peritoneum is brownish black.

Although certain rather wide variations are apparent, we have little doubt as to the unity of this species as we now define it.

Table of measurements in hundredths of length to anus.

	Type.	Type, *delta*.	Typical form.	Type, *alpha*.	*Alpha*.
Albatross station	5348	5172	5590	5589	5590
Total length in mm	320	300	.....	289	267
Length to anus in mm	129	106	116	105	103
Length of head	74	74	73	72	71.5
Length of orbit	19	21.5	19	21	21
Postorbital length of head	25	24	25	25.5	24
Width of interorbital	17.5	16	16.5	17.5	17
Width of suborbital	8.5	11.5	9.5	9.5	9
Orbit to preopercle	26	26	27	26	26.5
Length of snout	31.5	30.5	30.5	27	28
Length of upper jaw	19.5	18.5	21	20	20.5
Depth of body	34	39	34	37	35
Width of body	.....	33	27	30	30
Anus to ventral	24.5	25.5	26	27	25.5
Ventral to isthmus	23	22	23.5	22	26
Height of second dorsal spine	36	.....	.....	.....	33.5
Length of first dorsal base	12	13	13	14	12
Length of interdorsal space	19.5	18	19	22.5	23
Length of pectoral	31	32	.....	34	30
Length of outer ventral ray	28	29.5	27	34	.....
Length of second ventral ray	.....	19.5	16.5	22	18.5

(*commutabilis*, in reference to the supposed mutants, or "forms," which were originally confused with this species.)

40. COELORHYNCHUS MACRORHYNCHUS Smith and Radcliffe.

Coelorhynchus macrorhynchus Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1812, p. 127, pl. 29, fig. 1 (not *Coelorhynchus macrorhynchus* Weber, Fische der *Siboga*-Expedition, 1913, p. 162, pl. 4, figs. 2 and 2*a*; also p. 671).

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5111	China Sea, off southern Luzon	236	.....	6
5367	Verde Island Passage, southern Luzon	180	.....	Type.
5574	North of Tawi Tawi	340	.....	1
5575	North of Tawi Tawi	315	52.3	1
5587	Vicinity of Sibuko Bay, Borneo	415	42.3	1

We present the following notes and measurements based upon four small paratypes from *Albatross* station 5111.

Scales in $5\frac{1}{2}$ series from origin of second dorsal to but excluding the series perforated by the lateral line; the series midway between the occipital and postorbital ridges is enlarged; the spinules on

the scales of the median rostral ridge are in rows radiating from near front of scale; the lower half of the nasal fossa is scaled. Second dorsal, proximal part of first dorsal, and pectorals light.

Traces of vertical bars can be seen on the small specimen from station 5587.

Table of measurements of paratypes in hundredths of length to anus.

Albatross station	5111	5111	5111	5111
Total length in mm	[1] 187	[1] 213	[1] 202	[1] 150
Length to anus in mm	82	88	80	66
Length of head	82	83	83	82
Length of orbit	18	18	18	18
Postorbital length of head	23.5	24	24	23
Width of interorbital	14	14	13.5	14
Width of suborbital	7.5	8	7.5	8
Orbit to preopercle	24	26	26	24
Length of snout	41	41.5	41	41
Length of upper jaw	18.5	18.5	18	18
Depth of body	32	32	32	29
Width of body	24	27	25	25
Anus to ventral	17	18	16	17
Ventral to isthmus	20	21	20.5	18
Length of first dorsal base	10	10	10	11
Length of interdorsal space	17	17.5	17	16
Length of pectoral	23	26	25	25
Length of outer ventral ray	22	24	23	26
Length of second ventral ray	.....	14	14	.....

[1] Pseudocaudal developed.

(*macrorhynchus*, in reference to the long snout.)

41. COELORHYNCHUS ACUTIROSTRIS Smith and Radcliffe.

Coelorhynchus acutirostris Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 134, pl. 30, fig. 2, text figure 10.

This small species is one of the most distinct in the genus; its position in the subgenera into which we have divided *Coelorhynchus* is quite uncertain. The divergence of the spinous carinae on the scales, together with other characters shared in common with the species having that type of squamation, have influenced us to place it in the subgenus *Oxymacrurus*. In the quincunx arrangement of the spinules on the scales of the head and the bluntness of the subopercular flap the species bears some resemblance to those of the subgenus *Quincuncia*. Its close resemblance to *C.* (*Paramacrurus*) *gladius* of the Hawaiian fauna may indicate a close relationship with that species, as Radcliffe has already pointed out. It resembles *C. gladius* in the excessively long, pointed snout; in the two ventral fossae, one before the anus, the other before the ventral fins, and in the squamation of the head. In addition to the details enumerated by Radcliffe, *C. acutirostris* differs from *C. gladius* in having the spinules on the scales of the head arranged in quincunx order; the spinous carinae of the body scales decidedly divergent instead of parallel; in the lower first dorsal fin; and further in certain details of proportions, as indicated in the tables of measurements, and in certain other details mentioned in the following description of this species.

List of stations.

Albatross station	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5417	Between Cebu and Bohol	165	54.4	1
5418	....do	159	54.4	Type.
5516	Vicinity of northern Mindanao	175	54.3	1
5517	....do	169	54.3	1

In addition to the color marks described by Radcliffe, a dark streak extends along the anterior half of the tail immediately above the lateral line. The opercle is dusky, and a dark streak lies just below the postorbital ridge.

Scales in 5 series from origin of second dorsal fin to, but excluding, the lateral line scales; in 6 series behind anterior curve of lateral line. The 5 to 7 series of short, robust, suberect spinules on the scales of the body, moderately divergent posteriorly, become strongly divergent toward the head. The scales of the head, much as in the species of the subgenus *Quincuncia*, bear numerous suberect spinules arranged usually in quincunx order,[1] but sometimes in divergent or stellate series. The sharply acuminate tip of the snout is covered by a spinigerous plate above and below; the length of the dorsoterminal plate is about two-thirds that of the orbit (the two measurements are equal in *C. gladius*). These terminal plates are bounded on each side by a narrow scale, followed on the ethmoid region of the infraorbital ridge by six scales; the suborbital and preopercular regions of the ridge are covered more or less irregularly by two series of scales; the ridge ends sharply just before the margin of the produced preopercular lobe. The subopercle is produced backward, behind the upper margin of preopercular lobe, into a very obtuse, short flap, less prominent than in any other species of either *Paramacrurus* or *Oxymacrurus* examined. A long, narrow, scaleless groove, more prominent than in *C. gladius*, bounds along its entire length that series of scales on each side of the series on the median rostral ridge; a few scales (many in *C. gladius*) lie between this groove and the scales of the infraorbital ridge. The occipital ridges diverge toward their posterior ends, where they are separated by a distance one-third greater than the least distance between the ridges, a distance contained 1.7 to 1.9 times in the least interorbital width. From the many-spined median occipital scute there extends outward and forward a scaly ridge which meets the occipital ridge on each side above the hind margin of the orbit; this ridge is preceded on each side by series of strengthened scales; similar scales also cover the triangular area included between this short ridge and the occipital ridge on each side; another scaly ridge, formed over the supraoccipital crest,

[1] In numerous divergent rows in *C. gladius*.

extends backward from the occipital scute. The scales between the occipital and postorbital ridges are reduced in size, excepting those in the median series; a strong scute, pointed posteriorly and armed with several spinules, is present near the origin of the lateral line. The nasal fossa has a few scales in its anteroventral angle. The underside of the head is completely naked. Six branchiostegals; free fold of gill-membranes very narrow.

A ventral fossa about as long as the pupil and covered by thin and nearly smooth scales is located before the ventral fins. The usual gland-like organ which this fossa covers shows through the transparent scales. It is flat on its punctulate, yellowish outer surface, and black on its thick, rounded anterior edge and arched dorsal surface; it extends backward as a strand of glandlike substance, surrounded by a black membrane, to its black posterior dilation, which, located just before the anus, is covered by a small area in which the scales are thin.

In the sensory cavity lying in advance of the lateral line there are developed small neuromastic bones, like those described in some detail for *Coelorhynchus argentatus* (p. 434).

Eleven pyloric caeca (one specimen examined).

Table of measurements in hundredths of length to anus.

	Coelorhynchus acutirostris.		*Coelorhynchus gladius.*		
	Type.	*Paratype.*			*Paratype.*
Albatross station	5418	5417			3472
Total length in mm	205	190	[1] 237	157+	57
Length to anus in mm	87.5	81	96	65	23.5
Length of head	72	74	70	72	70
Length of orbit	16.5	17	14.5	16	22
Postorbital length of head	21.5	22	19	19	20
Width of interorbital	15	16.5	13.5	13.5	16
Width of suborbital	9	9	7.5	8	7
Orbit to preopercle	23	23	19	19	22
Length of snout:					
Preocular	35	37	36.5	39	31
Preoral	31	31	33	36	27
Width of snout:					
At base	23	25	21	22	27
At end of ethmoid portion of infraorbital ridge	17.5	19	15.5	18	24
Length of terminal rostral plate	10.5	10.5	13.5	16	7
Length of upper jaw	15	15	13.5	15	19
Length of barbel	4	4	5	4	
Depth of body below origin of first dorsal	33	35	27	27	32
Depth of body at twice length of head behind tip of snout	12	10	16	12	15
Width of body across pectoral bases	23	22	26	22	
Width of body at twice length of head behind tip of snout	4	3.5	10	8	7
Anus to ventral	24	21.5	26	29	27
Ventral to isthmus	23	21	17	18	19
Height of second dorsal spine	25	22	33	33	
Length of first dorsal base	11.5	10.5	12	11	
Length of first ray of second dorsal	4	4	9	9	
Length of interdorsal space	10	8	8	5	
Length of pectoral	21.5	25	26.5	26.5	
Length of outer ventral ray	23	21	24	26	41
Length of second ventral ray	15	15	16.5	17	
Fin rays:					
First dorsal	II, 8	[2] II, 8	II, 9	II, 9	
Pectorals	16–15	14–13	18–17	19–19	
Ventrals	7	7	7	7	

[1] Pseudocaudal developed. [2] First dorsal rays II, 8 in each of the four specimens.

(*acutirostris*, in reference to the sharply acuminate snout.)

OXYGADUS, new subgenus.

We unite into a subgenus certain species of *Coelorhynchus* which are distinguished by the spination of their scales: there is a very strong median spinous keel, with smaller lateral spinules, usually not set on keels, but arranged in series parallel with the median keel. In addition to the type-species, *C. parallelus* (Günther), it includes *C. kermadecus* Jordan and Gilbert, *C. spinifer*, new species, *C. aratrum* Gilbert, *C. doryssus* Gilbert, *C. occa* (Goode and Bean), *C. talismani* (Collett), and probably additional species hitherto confused with *C. parallelus*. The group is almost surely a natural one.

42. COELORHYNCHUS PARALLELUS (Günther).

Macrurus parallelus GÜNTHER, Ann. Mag. Nat. Hist., (4) vol. 20, 1877, p. 439; *Challenger* Reports, vol. 22, 1887, p. 125, pl. 29, figs. A′ and AA″. [figs. A, A″, a″, and a‴, probably represent a distinct species called *C. kermadecus* by Jordan and Gilbert (Bull. U. S. Fish Comm., 1902 (1904), p. 619). The specimens from New Zealand perhaps represent a third species.].—Japan; Kermadec Islands; New Zealand.

Coelorhynchus parallelus JORDAN and GILBERT, in Jordan and Starks, Bull. U. S. Fish Comm., 1902 (1904), p. 618.—FRANZ, Abh. Bayer. Akad. Wiss., vol. 4, Suppl. vol. 1, 1910, p. 26.—GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 181.—Japan.

?? *Macrurus parallelus* ALCOCK, Ann. Mag. Nat. Hist. (6), vol. 4, 1889, p. 391; Journ. Asiatic Soc. Bengal, vol. 43, pt. 2, 1894, p. 126; Desc. Cat. Indian Deep-Sea Fishes, 1899, p. 106.—Gulf of Manar.

?? *Macrurus parallelus* BRAUER, Die Tiefsee-Fische, 1906, p. 257 (probably a distinct species, having 7 or 9, usually 9, instead of 3 to 5 rows of spinules on the scales).—off southwestern Africa.

? *Coelorhynchus parallelus* WEBER, Fische der *Siboga*-Expedition, 1913, p. 163, pl. 4, fig. 3.—East Indies.

We refer to *C. parallelus* three small specimens from *Albatross* station 5445, off the east coast of Luzon (383 fathoms; bottom temperature, 44.3° F.). The scutes along the ridges of the head bear a strong keel armed by several spinules of subequal strength. Scales mostly lost; probably originally present on under surface of head; 5 scales in a series above lateral line (to origin of second dorsal).

The measurements given by Weber indicate that his specimens have the snout shorter than in our Japanese material. Concerning the spination of the scales, Dr. Weber writes: "A specimen from station 52 of 220 mm. length shows *about* the following arrangement of spinules: 2. 3. 4. 3. 2=14. A specimen from same station of 125 mm. length shows on well-developed scales the arrangement: 2. 2. 2=6."

Although it is evident that several species have been confused with *C. parallelus*, we do not feel justified in naming or defining them on the basis of published descriptions.

We have prepared a table of measurements of our three small specimens with which are included measurements of typical *C. parallelus* from Japan. The relative lengths of the different specimens should be constantly considered when their measurements are being compared.

Table of measurements in hundredths of length to anus.

	Philippine Islands.			Japan.			
Albatross station	5445	5445	5445	4909	4909	4906	4908
Total length in mm	121	.....	128	[1] 249	.....	104	83
Length to anus in mm	47	47	47	99	72	32	27
Length of head	76	78	78	69.5	73	76	79
Length of orbit	23	23	22	19	21	22	22
Postorbital length of head	22	23.5	23.5	22	22.5	25	24
Width of interorbital	18	18	18	15.5	17	17	16
Width of suborbital	9	9	9	9	10	10	.....
Orbit to preopercle	26	27	26	23	23	26	.....
Length of snout	33	35	36	30	32	30	33
Length of upper jaw	19	19	20	16.5	16.5	.....	19
Length of barbel	7	5	5	4	5	.....	.....
Depth of body	33	34	32	33	30	29	32
Width of body	.....	24	24	28	.....	25	.....
Anus to ventral	20	21	22	27	25	23	24
Ventral to isthmus	20	18.5	18	17	16	16	16
Length of first dorsal base	13	14	13	11	11	10	14
Length of interdorsal space	15	14	16	13.5	12.5	.....	.....
Length of outer ventral ray	29	35	34	25	27	.....	.....
Length of second ventral ray	14	16	.....	12.5	15	.....	.....

[1] A pseudocaudal developed.

(*parallelus*, in reference to the arrangement of the series of spinules on the scales.)

43. COELORHYNCHUS SPINIFER, new species.

? *Coelorhynchus macrorhynchus* WEBER, Fische der *Siboga*-Expedition, 1913, p. 162, pl. 4, figs. 2 and 2*a* (not a synonym of *C. macrorhynchus* Smith and Radcliffe, as suggested by Weber on p. 671).

This remarkable new species is related rather remotely to *C. parallelus;* it differs from that species in having the orbit smaller; the snout longer and with more convex sides; the spinules on the scales notably longer and stronger, particularly on the ridges of the head. *C. spinifer* is probably the most strongly spined species of the genus. It was dredged at a greater depth than that inhabited by most of the other species. (A specimen of *Bathygadus multifilis* was also dredged at the type-station of this species.)

Type-specimen.—Cat. No. 78226 U.S.N.M.: 185 mm. long to the end of its whip-like tail, 66.5 mm. to the anus; *Albatross* station 5607, in the Gulf of Tomini, Celebes (0° 04′ S., 121° 36′ E.); depth, 761 fathoms.

Fin-rays—first dorsal, II, 9; pectorals, 19–18; ventrals, 7.

The dorsal and ventral contours are not strongly arched, but converge rather rapidly behind the trunk; the dorsal contour of the snout is almost straight (a little concave in *C. parallelus*); the base

of first dorsal is not oblique. Greatest depth of body, below origin of first dorsal, 2.33 in length of head; greatest width, across pectoral bases, 3.0; the depth, at a distance behind snout twice the length of head, is contained only twice in the postorbital length, and is about 3 times the width of the tail at the same point. The sides of the head are convex; the snout is heavy and broad; its preocular length is contained 2.15 times in length of head; it preoral length, 2.3 times; its width at base, 2.65 times; the width of the snout at anterolateral angles is a little less than the length anterior to that point. The infraorbital, occipital, supranarial, supraorbital, and postorbital ridges are exceedingly strong and heavily spined. The preopercular ridge and margin are oblique; the sharply pointed flap of the subopercle, concealed by the produced lobe at the angle of the preopercle, is

FIG. 30.—COELORHYNCHUS SPINIFER. TYPE.

directed downward and backward, and is almost as long as the pupil. The orbit is oval and small; its length is equal to the least interorbital width, and is twice the least distance between the occipital ridges; orbit 4.3 in head, 2.0 in snout, 1.3 in postorbital. Least suborbital width, 2.4 in postorbital. The upper jaw extends from below the posterior nostril backward to below the hind margin of the pupil; its length is contained 4.65 times in the head. The barbel is slender and very short, being contained 7.5 times into the postorbital. The teeth are in rather narrow bands in the jaws; there are only about three teeth in a cross section of the mandibular band laterally. Six branchiostegals.

Distance between isthmus and base of ventral, 1.4 in distance from base of ventral to center of anus, 1.5 in postorbital length. There are no naked areas on the breast.

The scales are large, being in $4\frac{1}{2}$ rows from the origin of the second dorsal to but excluding the lateral line series; this number does not

increase at the end of the low anterior arch in the lateral line. The scales are armed very strongly by a sharply 3-angled spine, which is about two-thirds as high as the width of the scale; this spine from its widened base is directed upward and backward at an angle of about 65°, extending to a point directly above the hind margin of the scale; this main spine is preceded by one to three smaller imbricate spinules; a single spinule is sometimes present above or below the median keel. In *C. parallelus* of comparable size there are three to five parallel rows of several spinules, which increase in strength along the median keel much less abruptly posteriorly. The scales on the infraorbital ridge before middle of eye are in a single series and bear two or three spinous keels like the main one on the scales of the body; behind middle of orbit the scales of the infraorbital ridge are armed by a single, very strong, broad keel, the main spine of which is about one-third as high as the diameter of the pupil; the ridge ends in a single, hard, strong scale, pointed posteriorly, and bearing a heavy, retrorse spine, which is preceded by a few small spinules; this spine extends backward to within its own length of the preopercular margin. The 12 scales on the median rostral ridge bear about three series of spinules, except the last one, which has only the strong median keel, composed of three spinules. The remaining scales of the head bear but a single keel, like that on the body scales; the spines on the ridges are greatly strengthened and enlarged; the height of the tip of the spines from the base of the occipital ridge is about half the diameter of the pupil, being twice as great as in *C. parallelus*. The four series of scales between the occipital ridges converge backward to the middle of a naked area lying before the two strong occipital scutes, which lie side by side, and represent the single weaker median scute of *C. parallelus*. The series of scales midway between the occipital and postorbital ridges is little enlarged; about three scales, larger than those surrounding them, extend backward from the orbital rim to the preopercular ridge (a similar series occurs in *C. parallelus*). The under surface of the head is completely covered by deciduous prickle-like scales.

The second dorsal spine is weak and smooth. The length of the first dorsal base is contained 1.2 times in the interdorsal space, 2.4 times in the postorbital length of the head. The first ray of the second dorsal fin is shorter than the pupil. The rays of the pectoral fin are slender and weak; the filamentous outer ventral ray extends to the origin of the anal fin, and is equal in length to the postorbital region of the head; the other ventral rays are weak and short, not nearly reaching to the anus.

Color pale brownish in alcohol, black over the coelom; pale greenish on head, becoming blackish on the opercles, about the

mouth, and on the gular and branchiostegal membranes. Lining of buccal and branchial cavities, wholly blackish; parietal peritoneum, brownish black. Fins dusky, the pectorals and ventrals dark; outer ventral ray, light.

Measurements in hundredths of length to anus (66.5[1] mm.).—Length of head, 77; length of orbit, 18; postorbital length of head, 24; least width of interorbital, 18; least width of suborbital, 10; distance between orbit and preopercular margin, 24.5; preocular length of snout, 36; preoral length of snout, 34; width of snout at base, 29; width of snout at end of ethmoid portion of infraorbital ridge, 24; length of maxillary, 16.5; length of barbel, 3; depth of body below origin of first dorsal, including the spines on the scales, 35; width of body over pectoral bases, 28; distance from center of anus to base of outer ventral ray, 21; distance from base of ventral to front of scaly area on isthmus, 16.5; length of first dorsal base, 10.5; length of interval between dorsals, 12.5; length of outer ventral ray, 23.

(*spinifer*, in reference to the relatively immense spine borne on each scale).

Genus HYMENOCEPHALUS Giglioli.

This genus, which comprises a number of small and fragile species dwelling in the moderate depths of tropical seas, has been defined in detail by us in our Report on the Macrouroid Fishes of Japan.[2] Since the appearance of that report we have described[3] an interesting new species, *Hymenocephalus tenuis*, from the Hawaiian Islands. In the present report we are basing a new subgenus on a new Philippine species and this recently described Hawaiian form; in addition to these, another new subgenus, two other new species, and one new subspecies are now added to the list. The inclusion of these new types makes necessary certain modifications of the generic description: the dorsal spine may be weakly denticulate, and the gill-rakers may be short and tubercular, and they may be as few as 10 on the lower limb of the outer two arches, thus attaining the reduced condition which is characteristic of the other genera in the Coryphaenoidinae. Even with these modifications the genus remains a compact group, but its position in the subfamily now seems somewhat less isolated than it did before the discovery of these new facts, and its relation to *Bathygadus* is rendered much less apparent.

[1] About 1 mm. has been added as an estimate of amount broken off from the tip of the snout.

[2] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 137, 141, 186.

[3] Idem, vol. 54, 1917, p. 173.

ANALYTICAL KEY TO THE SUBGENERA AND SPECIES OF HYMENOCEPHALUS.[1]

A¹. Body and head slender or moderately robust; sensory canal system of head not excessively developed; bony crests of skull thin, but firmer; eye very large, being contained from 2.5 to 3.5 times in length of head; color chiefly silvery.

B¹. Second dorsal spine weakly denticulate; body more slender; the head not compressed, its width equal to greatest depth of body or of head; gill-rakers tubercular, about 10 to 13 on the lower limb of the outer two arches; scales wholly smooth, so far as known.

HYMENOGADUS.

a¹. Lens-shaped organ before anus circular in outline; striations on sides of isthmus well developed; gill-rakers about 12 in number on lower limb of outer two arches; barbel nearly as long as orbit ——— *gracilis.*

a². Lens-shaped organ before anus elongate; striations on sides of isthmus obsolescent; gill-rakers about 10 in number on lower limb of outer arches; barbel not quite half length of orbit ——— *tenuis.*

B². Second dorsal spine wholly smooth; body more robust; head compressed, its width being less than depth of body or of head; gill-rakers short but not tubercular, about 18 in number on outer arches; scales with short spinules arranged in quincunx order ——— HYMENOCEPHALUS.

a¹. Barbel much longer than the orbit; ventral fins with 8 rays.

b¹. Pectoral rays 11; barbel two-thirds length of head ——— *longibarbis.*

b². Pectoral rays 15; barbel less than two-thirds length of head; snout and maxillary longer, and eye smaller than in Günther's figure of *longibarbis* ——— *longiceps.*

a². Barbel much shorter than orbit, often obsolete.

c¹. Ventral rays greatly produced beyond anus, 8 in number; no barbel ——— *longipes.*

c². Ventral rays little or not at all produced beyond anus.

d¹. Ventral rays 7 or 8 (rarely 6 or 9); snout scarcely produced beyond the mouth.

e¹. Barbel developed; interorbital width about equal to length of orbit, or less ——— *striatissimus.*

f¹. Ventral rays 8 (rarely 7 or 9); barbel usually about as long as pupil, or longer.

g¹. Orbit nearly circular, contained 0.9 to 1.1 times in postorbital length of head ——— *s. striatissimus.*

g². Orbit obliquely oval, its length contained 1.15 to 1.4 times in postorbital length of head ——— *s. aeger.*

f². Ventral rays 7 (rarely 6, never 8); barbel usually shorter than pupil ——— *s. torvus.*

e². Barbel absent; interorbital space one-third wider than eye; ventral rays 8 ——— *grimaldii.*

d². Ventral rays 10 to 14.

h¹. Orbit 2.5 to 3.25 in head; its length greater than the interorbital width.

i¹. Snout much shorter than the interorbital width, not projecting beyond the mouth, rounded.

j¹. Barbel small, but distinctly developed; a small, distinct, faintly striated area directly below base of pectorals, and one before base of each ventral.

[1] The authors have examined all of the 19 species and subspecies now known, excepting *H. longibarbis* and *H. grimaldii.*

k^1. Striations behind ventral fins much finer than those above ventrals or on isthmus; form more slender_____*italicus.*

k^2. Striations behind ventral fins not finer than those above ventrals or on the isthmus; form more robust_____*cavernosus.*

j^2. Barbel minute or obsolete; no striated areas directly below pectoral bases nor in front of ventral bases; compared with *cavernosus*, the ventral lens-like bodies are smaller, the color is darker, and the bands of teeth are narrower____*antraeus.*[1]

i^2. Snout about as long as the interorbital width, projecting beyond mouth, pointed; barbel wholly absent, or rudimentary.

l^1. Color lighter, grayish along bands of teeth in jaws.

m^1. Ventral rays usually 11, sometimes 12_____*lethonemus.*

m^2. Ventral rays usually 12, sometimes 11 or 13_____*nascens.*

l^2. Color darker, black along bands of teeth in jaws; ventral rays 13 to 15_____*striatulus.*[2]

h^2. Eye 3½ in head, ⅝ interorbital width; snout ¾ eye; barbel distinctly developed; ventral rays 10 to 12 (readily separable on account of its small orbit from *H. italicus* and *H. cavernosus*, the only species in the subgenus with which it agrees in the number of ventral rays and the development of the barbel) _____ *heterolepis.*

A'. Body deeper; sensory canals of head excessively developed, as in the typical subgenus of *Bathygadus;* bony septa of skull exceedingly thin and papery; eye small, 4 to 5 in head; color chiefly blackish.

PAPYROCEPHALUS.

a^1. Barbel present, very small.

b^1. Ventral rays 7_____*barbatulus.*

b^2. Ventral rays 11_____*papyraceus.*

a^2. Barbel absent; ventral rays 13 or 14_____*aterrimus.*

HYMENOGADUS, new subgenus.

Type-species.—Hymenocephalus gracilis, new species.

This subgenus is erected to include two closely related species—the type-species and *H. tenuis*[2]—which we have recently described from the Hawaiian Islands. The two species are closely related, and differ strikingly from all other known species in the denticulation of the dorsal spine, in the reduced gill-rakers, and in the cylindrical form of the head. Their reference to *Hymenocephalus* is made because of their agreement with the other species of the genus in the possession of certain diagnostic characters conservatively retained throughout the group. Among these characters the most prominent are: the forward extension of the branchial aperture;[3] the comparatively wide slit before the first gill-arch; the "striation" of the abdominal region; the presence of two lens-like bodies in constant

[1] Specimens of this Hawaiian species from *Albatross* station 3467 have never been recorded.

[2] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 54, 1917, p. 173.

[3] In this character *Hymenocephalus* is approached by two other genera, *Malacocephalus* and *Ventrifossa.*

position on the midventral line;[1] the large size and subterminal position of the mouth; the development of the sensory canal system[2] of the head, with thin bony septa connected by thin external membranes;[3] the large size and thinness of the scales; and the correlated position of the anus (immediately before the anal fin) and the number of branchiostegal rays (7).

44. HYMENOCEPHALUS GRACILIS, new species.

Type-specimen.—Cat. No. 78227, U.S.N.M., 96 mm. long to end of pseudocaudal, 29 mm. long to anus; dredged by the steamer *Albatross* at station 5292, in the China Sea off southern Luzon (lat. 13° 28′ 45″ N.; long. 121° 01′ 12″ E.); depth, 162 fathoms; bottom temperature, 52.4° F.

Fin-rays—first dorsal, II, 10; pectorals, 13; ventrals, 8.

The form of the body is entirely similar to that of *H. tenuis*. It is slender throughout, the depth gradually decreasing toward the end of tail; the width of the head, equal to the greatest depth of either head or body, is contained twice in length of head. The sides of the head are strongly convex; the head in cross section is round, instead of rectangular as in *H. striatissimus*. The snout projects forward beyond the tip of the premaxillaries a horizontal distance half as long as the pupil; preocular length of snout, 1.4 in length of orbit, 3.2 in length of head. The orbit is oval in outline; its length is contained 1.25 times in the postorbital, or 2.9 times in the entire length of head. The middle of the length of the head is at the hind margin of the pupil. The orbit encroaches medially upon the interorbital, the sides of which, in consequence, are strongly concave; the least interorbital width is contained about 5 times in the head, being not much more than half the orbital length; least suborbital width, 0.3 length of orbit. The mouth is large and a little oblique; the upper jaw, which extends backward to a vertical intersecting the eye behind the pupil, is contained 2.25 times in the head. The small teeth are arranged in narrow bands in the two jaws. The preopercular ridge, as in *tenuis*, is rounded at its angle, not being acutely produced backward as in the subspecies of *striatissimus;* the preopercular margin is widely rounded, and but little produced backward. The head, as in *tenuis*, is comparatively firm, and the sensory canals, though spacious, are much less developed than in such species as *striatissimus;* these canals are covered over by delicate membranes supported by thin bony septa.

The gill-membranes, free from the sides of the isthmus, extend forward to below end of maxillary, where they form a narrow free fold

[1] Somewhat similar and doubtless homologous structures occur in other genera, particular in certain species of *Ventrifossa*, such as *V. nigromarginata* (q. v.).

[2] The head is firmer in *Hymenogadus* than usual in the other groups.

[3] In this character *Hymenocephalus* is approcahed by certain species of *Ventrifossa*.

across the isthmus. The short spiny gill-rakers are fewer than in any form previously described with the exception of *tenuis*, there being but 12 or 13 on the outer two arches; the first gill-arch is bound down by membrane above its angle and near its anterior end. Seven branchiostegals.

The anus is located immediately before the origin of the anal fin, its distance from the base of the outer ventral ray being equal to the distance from tip of snout to hind margin of orbit, and a little longer than the distance between the ventral base and the isthmus at the fold of the gill-membranes.

The two ventral lens-shaped bodies are present in the usual positions; both are circular in outline; the diameter of the anterior one, located in advance of the ventrals, is about two-thirds that of the posterior one, which is situated immediately before the anus. The

FIG. 31.—HYMENOCEPHALUS GRACILIS. TYPE.

two organs, as usual, are connected by a black-surfaced strand of tissue along the inner surface of the abdominal body wall.

The scales are almost entirely lost, but three are present near the origin of the lateral line; two are overlapped by the last of the scale-like bones flooring the sensory canal in advance of the lateral line. The scales are round and marked with concentric striae, but are wholly spineless. One, bearing a lateral line pore, is separated from the origin of the first dorsal by 2½ rows of scales.

This species is sharply distinguished from all others of the genus previously described, with the exception of *H. tenuis*, by the presence of weak denticulations on the distal portion of the dorsal spine; the spine is broken, but 5 denticulations remain on a distal portion only half as long as the orbit; the proximal smooth portion of the spine is two-thirds the postorbital length. The length of the first dorsal base is about half the interval between the dorsals, or two-thirds the postorbital. The rays of the paired fins are exceedingly slender and weak; the pectoral fin is just equal in length to the postorbital.

portion of the head; the outer ventral ray, with its filament, extends to the front of the peritroct, and is contained 1.9 times in the head; the inner ventral rays are not quite half as long as the orbit, and extend but halfway to the origin of the anal fin, the vertical from which passes behind the first dorsal a distance half as long as the fin itself; the height of the first anal ray and of the orbit are equal.

The trunk is silvery between the anus and the ventral bases and on an area extending thence forward along the sides of the isthmus and upward to the middle of the sides; this silvery region is continued backward as a streak occupying the middle third of the sides of the tail; the abdominal region before the ventral fins has a coppery luster; the immediate bases of the paired fins are blackish; a fine black ring surrounds each of the lens-shaped structures on the belly; the rest of the body is brownish, becoming dark below the first dorsal fin. The markings of the head consist of a dark brown region about the occiput; a dark streak along the margins of the postorbital sensory canals, and narrow black streaks along the front margin of the snout, along the inner margins of the lips, and along the sides of the central canal in each mandibular ramus. The sides of the head are bright silvery, but the black lining of the branchial cavity shows through the opercle. The membranes over the sensory canals are transparent, allowing the coloration of the walls of the canals to be visible; the vertical wall of the suborbital cavity is silvery, but its roof is dark; the floor of the interorbital cavity is blackish. The buccal and branchial cavities are lined with silvery everywhere excepting a margin about as wide as the pupil on the outer posterior sides of the branchial cavity; this dark is margined at the extreme edge of the opercular and branchiostegal membranes by a whitish line. The parietal peritoneum is silvery with some diffused brownish color and black spots.

The "striated" region of the belly consists of a strip, about as wide as the pupil, extending along the sides of the isthmus and backward to above the base of the ventral fin, from which place the striae fade out posteriorly, being traceable about halfway to the anus. The striae are similar to but more extensive than those of *tenuis;* they are finer than those of *striatissimus*, and do not occur, as in that species, on a thickened portion of the skin below the postclavicle. The end of that bone is much nearer the base of the ventrals than the anus, the reverse of its position in *striatissimus*. The gular membrane lacks the median black streak of *striatulus*, and lacks the double striation characteristic of *striatissimus;* it is marked only by numerous black lines somewhat coarser than those on the striated region of the belly.

H. gracilis is widely separated from all other species of the genus with the exception of the recently described *H. tenuis*, from which species it differs in the circular form of the lens-shaped organ before the anus; in the better development of the striations on the sides of the isthmus; in the less reduced character of the gill-rakers, and in the greater length of the barbel.

Only the type-specimen is known.

(*gracilis*, in reference to the slender form.)

Subgenus HYMENOCEPHALUS Giglioli.

45. HYMENOCEPHALUS LONGICEPS Smith and Radcliffe.

Hymenocephalus longiceps SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 111, pl. 23, fig. 3.

Hymenocephalus striatissimus WEBER, Die Fische der *Siboga*-Expedition, 1913, p. 168 (specimen from *Siboga* station 38).

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5301	China Sea, near Hongkong	208	50.5	1
5317	China Sea, near Formosa	230	50.6	1
5440	China Sea, off western Luzon	172	53.2	1
5441	do	186	52.2	1
5117	China Sea and adjacent waters off southwestern Luzon	118	.....	3
5118	do	159	.....	1
5265	do	135	.....	1
5290	do	214	.....	1
5291	do	173	51.5	11
5292	do	162	52.4	1
5375	Vicinity of Marinduque Island	107	.....	1
5121	Off east coast of Mindoro	108	.....	9
5197[1]	Vicinity of western Bohol	174	54.3	1
5411	Between Cebu and Bohol	145	55.2	7
5412	do	162	54.8	3
5453	Off southeast coast of Luzon	146	.....	8
5454	do	153	.....	2
5459	do	201	.....	[2]3
5476	do	270	48.3	1
5565	Between Jolo and Tawi Tawi	243	52.3	1
5566	do	244	52.5	1
5580	Vicinity of Darvel Bay, Borneo	162	55.8	5
5621	Between Gillolo and Makyan Islands (0° 15′ 00″ N., 127° 24′ 35″ E.).	298	.....	2

[1] The data corresponding to the tag borne by this specimen is: station 5179, Apr. 9, 1908. As station 5179 was occupied on Mar. 25, at a depth of only 37 fathoms, it seems likely that 5179 was written for 5197 (occupied on Apr. 9).

[2] One of these specimens is the type of the species (Cat. No. 72928, U.S.N.M.).

We have a few notes to add to the original description.

The tail ends in a very long filament, the tip of which is broken off in the type; the head is contained about 6.5 times in the total length when the tail is entire.

The posterior lens-shaped body, lying just before the anus, is unusually large in this species, being about half as wide as the pupil;

its posterior margin is bilobed, being divided by the anus; the organ is raised above the surface of the body, has a clear glassy appearance, and is punctulate on its outer face; this posterior organ is connected by a median black strand of tissue with the anterior lens-like body, which is similar but much smaller, and is located before the ventrals. There can be little doubt that these structures are homologous with those described by us in other species of this genus and in species of other genera, as in *Coelorhynchus argentatus* (p. 435).

Many of the scales still remain on a few specimens. These scales are beset with short, weak spinules, as in other species of the subgenus, being similar in arrangement to those figured for *H. longipes*.[1] The midline of the belly, even over the anterior lens-like organ, is scaled, contrary to a statement in the original description; the scales themselves are usually lost, but the scale pockets can be made out. The position of the lateral line was incorrectly given in the type description; it rises anteriorly, as in *H. longipes*, so that there are 3, instead of 5, large scales from the end of the first dorsal to and including the lateral line series.

The striation of the abdominal region agrees in its wide extent with that of *H. striatissimus*, *italicus*, and *cavernosus*. The striated region includes the area encircling the base of each ventral fin, and regions extending backward about half way to the anus, upward to before the pectoral base, and forward along the entire sides of the isthmus; the gular membrane is completely covered by similar but somewhat finer striations, in addition to the cross lines of black, which are less sharply developed than in most species.

Branchiostegals 7, as in all other species examined. Günther's count of 6 in his *longibarbis* is doubtless an error, due to the small size of his type specimen.

Table of fin-ray counts.

Albatross station.	Soft rays, first dorsal.	Pectoral rays.	Ventral rays.
[1] 5459	9	14	8
5118	10	14	8
5621	9	15	8
5476	9	15	8
5565	9	16	8
5590	10	16	8
5441	10	14	8
5621	10	17	8
5566	9	16	8
5459	9	14	8

[1] Type.

(*longiceps*, in reference to the comparatively long, slender head.)

[1] Proc. U. S. Nat. Mus., vol. 43, 1912, pl. 23, fig. 1.

46. HYMENOCEPHALUS LONGIPES Smith and Radcliffe.

Hymenocephalus longipes Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 109, pl. 23, fig. 1.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5118	Off southwestern Luzon	159		1
5216	Between Burias and Luzon	215	51.9	1
5222	Between Marinduque and Luzon	195	52.8	1
5372	Vicinity of Marinduque Island	150		1
5374	....do	190		5
5387	Between Burias and Luzon	209	52.4	1
5403	Between Leyte and Cebu	182	55.7	7
5412	Between Cebu and Bohol	162	54.8	1
5417	....do	165	54.4	1
5418	....do	159	54.4	2
5421	Between Panay and Guimaras	137	58.4	Type
5502	Off northern Mindanao	214		1
5542	....do	200	54.3	2

When the tail is entire, the head is contained six times in the total length; the greatest width of the head is contained twice in its length; the middle of the length of the head is not at the posterior margin of pupil, being nearer to the posterior rim of the orbit, varying from midway between pupil and hind margin of orbit to the hind margin of the orbit. Preocular length of snout, contained 4.2 (4.0 to 4.8 in paratypes) times in length of head to end of membrane at angle of opercle; orbit, 3.35 (2.8 to 3.4); interorbital, 5.7 (4.8 to 6.4); length of upper jaw, 1.8 (1.75 to 2.0). Branchiostegals, 7.

The posterior lens-shaped body is about half as wide as the pupil; its posterior margin is emarginate, as in *longiceps;* the anterior organ is similar but slightly smaller, and is located, as in all other species, on the mid-ventral line between the ventrals and the isthmus. The region between the pectoral and ventral fins and the anus is not naked, as originally described, but is covered with thin, spineless scales.

The striation of the belly is extensive, as in *H. striatissimus*, *italicus*, *cavernosus*, and *longiceps*. The base of each ventral fin is surrounded by this striated area, which extends thence backward nearly to the anus, leaving a median non-striated strip; the region before and below the pectoral bases, the entire sides of the isthmus, and the gular membrane are all striated; the black cross lines on the gular membranes are not strongly developed.

(*longipes*, in reference to the produced ventral fin.)

47. HYMENOCEPHALUS STRIATISSIMUS Jordan and Gilbert.

This species was dredged in large series by the *Albatross* about the Philippine Islands. The large number (472) of specimens available has made possible a detailed study of the material, which has led us

to the following conclusion: *there are in the Philippine Islands, and in the adjacent regions to the northward and southward, three geographical subspecies which apparently intergrade in the two regions where their ranges meet.* The typical *striatissimus*, originally described from Japan, ranges southward to China, Formosa, and the east coast of Luzon. It intergrades off the northwest coast of Luzon with the subspecies *torvus*, which inhabits the Sulu Sea and the China Sea off southern Luzon. The form *torvus* then intergrades, along the Tawi Tawi Archipelago, with the third subspecies, *aeger*, which inhabits the East Indian Islands south of the Philippines.

The diagnostic characters, in so far as we have been able to analyze them, seem to be but three or four in number:

1. The ventral rays in *striatissimus* and *aeger* are 8 in number, while in *torvus*, which occupies a region between the other two forms, there are 7.

2. The orbit is nearly circular and very large in *striatissimus*, but smaller and more obliquely elongate in *torvus* and *aeger*.

3. The barbel is usually longer than the pupil in the southern form *aeger*, about as long as the pupil in the typical *striatissimus* and usually shorter than the pupil in the central subspecies, *torvus*.

4. The color may average darkest in *torvus*, but the character is not constant and is not very valuable in distinguishing the subspecies.

It will be noted that the intergrades between *striatissimus* and *torvus* have the eight ventral rays of the former, but usually have the small and less regular orbit and the short barbel of *torvus*. The intergrades between *torvus* and *aeger* likewise usually have eight ventral rays, and have the small irregular orbit as in both *torvus* and *aeger*. It follows from these facts that the two sets of intergrades are difficult to distinguish from one another, although the three typical forms may readily be separated. The chief average difference between the intergrades seems to be in the length of the barbel, which averages greater in the specimens from the Tawi Tawi group than in those from off northwest Luzon.

Tables showing the diagnostic characters of the subspecies of Hymenocephalus striatissimus and of the intergrades between these subspecies.

VENTRAL RAYS.[1]

Species.	6	7	8	9
striatissimus[2]			70	2
Intergrades		2	44	
torvus	4	302		
Intergrades		30	111	
aeger		2	125	

[1] Number of fins, not specimens, are enumerated; the number is often not the same on the two sides o the same fish.

[2] Japanese material included; the types, not here listed, also have 8 ventral rays.

Tables showing the diagnostic characters of the subspecies of Hymenocephalus striatissimus and of the intergrades between these subspecies—Continued.

ORBIT IN PASTORBITAL.[1]

Subspecies.	0.9 or 0.95	1.0 or 1.05	1.1 or 1.15	1.2 or 1.25	1.3 or 1.35
striatissimus	5	1			
Intergrades		3	7	4	
torvus		7	39	50	4
Intergrades		3	22	17	
aeger		5	24	12	2

BARBEL.[1]

Subspecies.	½ or ⅔ pupil.	About ¾ pupil.	About = pupil.	Longer than pupil.
striatissimus		11	12	5
Intergrades	15	3		
torvus	91	3	1	
Intergrades	18	19	4	
aeger	1	9	9	23

[1] Measurements of the orbit and barbel do not include Japanese specimens, which agree with typical *striatissimus* from China, Formosa, and the Philippines.

48. HYMENOCEPHALUS STRIATISSIMUS STRIATISSIMUS Jordan and Gilbert.

Hymenocephalus striatissimus JORDAN and GILBERT, Bull. U. S. Fish Comm., 1902 (1904), p. 612, text figure.—GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 187.

Hymenocephalus striatissimus RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 111.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5301	China Sea near Hongkong	208	50.5	8
5317	China Sea near Formosa	230	50.6	5
5476	Off southeastern Luzon	270	48.3	19

As in the two other subspecies, *torvus* and *aeger*, the posterior lens-like organ, which is located immediately in advance of the anus, is transversely elongate and bilobed, being almost dumb-bell shaped.

The orbit in this, the typical subspecies, is large and almost exactly circular in outline, the oblique diameter being about equal to the vertical diameter.

The ventral rays are constantly 8 in number; the only varying specimens are 2 from near Formosa, which have 8 rays on one side, 9 on the other.

(*striatissimus*, in reference to the extensive development of the abdominal striation.)

INTERGRADES BETWEEN HYMENOCEPHALUS STRIATISSIMUS STRIATISSIMUS AND H. S. TORVUS.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5325	Off northern Luzon	224	53.2	15
5326	do	230	55.4	3
5328	do	150	53.9	1
5329	do	212	51.4	4
5331	Off western Luzon	178	54.7	1
5440	do	172	53.2	1

The status of these 23 specimens and their relation to the two subspecies occurring on each side of their range have already received consideration. They resemble *H. s. torvus* in the small, obliquely elongate orbit, and in the short barbel, but usually agree with *H. s. striatissimus* in the number of ventral rays: 21 specimens have 8 on each side, and 2 have 8 on one side and 7 on the other. Over 70 fins have been counted in *striatissimus*, and none were found with 7 rays; 306 fins counted in *H. torvus* include none with 8.

49. HYMENOCEPHALUS STRIATISSIMUS TORVUS Smith and Radcliffe.

Hymenocephalus torvus Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 110, pl. 32, fig. 2.

The type-specimen was stated, in the original description, to have been dredged at station 5548, near Jolo. This statement is erroneous, as the specimen was dredged at *Albatross* station 5508, off northern Mindanao, at a depth of 270 fathoms.

The lateral line is on the fourth row of scales below end of first dorsal (not the sixth, as originally described). The scales are thin and deciduous, as usual in the genus; they are weakly armed with small spinules in quincunx order. The abdominal region, which is striated exactly as in typical *striatissimus*, is completely covered by spineless scales, as in the two other subspecies.

The roof of the buccal cavity is mostly silvery, but dusky just within the mouth and whitish on the tongue. The branchial cavity is brownish above, but mostly silvery below and whitish along the margin of the opercular and branchiostegal membranes. The parietal peritoneum is brownish, underlain with silvery.

The orbit is smaller in this subspecies than in typical *striatissimus*, and is not circular, as originally described; its vertical height is contained about 1.2 times in the oblique length, which is contained from 1.1 to 1.4 times in postorbital length of head (measured in 100 specimens).

List of stations.

Albatross stations.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5110	China Sea off southern Luzon	135	59.0	1
5112	....do	177	52.4	1
5113	....do	159	.....	1
5118	....do	159	.....	2
5122	East coast of Mindoro	220	.....	2
5198	Vicinity of western Bohol	220	53.9	2
5221	Between Marinduque and Luzon	193	52.4	10 plus [1] 3.
5222	....do	195	52.8	2
5259	Off northwestern Panay	312	49.3	4
5260	Off southwestern Mindoro	234	51.4	5 plus [1] 40.
5268	Off southern Luzon	170	.....	1 plus [1] 3.
5269	....do	220	.....	2
5279	....do	117	.....	1
5280	....do	193	49.6	1 plus [1] 5.
5282	....do	248	47.4	7 plus [1] 15.
5283	....do	280	46.8	[1] 3
5289	....do	172	.....	1
5291	....do	173	51.5	1
5294	....do	244	48.4	3
5303	Balayan Bay, Luzon	180	.....	12
5305	....do	214	.....	7 plus [1] 12.
5308	Near Marinduque Island	181	.....	1
5371	....do	[2] 83	.....	1
5374	....do	190	.....	5
5409	Between Cebu and Leyte	189	.....	6
5418	Between Cebu and Bohol	159	54.4	1
5419	....do	175	54.5	1
5501	Northern Mindanao and vicinity	214	54.3	7
5502	....do	214	.....	24
5503	....do	226	53.3	8
5504	....do	200	54.3	1
5505	....do	220	.....	3
5506	....do	262	53.3	9
5508	....do	270	53.3	Type.
5508	....do	270	53.3	6
5535	Between Cebu and Siquijor	310	53.3	4
5536	Between Negros and Siquijor	279	53.5	2
5537	....do	254	53.5	11
5542	Northern Mindanao and vicinity	200	54.3	3
				159 plus [2] 81.

[1] The condition of these specimens makes them almost unrecognizable; they are assumed to be *torvus*.
[2] Depth estimated from chart; probably an error.

The diagnostic characters of this subspecies, which is confined to the west-central region of the Philippine Islands, are given under the head of *Hymenocephalus striatissimus*.

(*torvus*, staring, from the large eyes.)

50. HYMENOCEPHALUS STRIATISSIMUS AEGER, new subspecies.

Hymenocephalus striatissimus WEBER,[1] Fische der *Siboga*-Expedition, 1913, p. 168 (part, includes also *H. longiceps*, q. v.).

Type-specimen.—Cat. No. 78228, U.S.N.M., 158 mm. long to end of whip-like tail, 40 mm. long to anus; dredged at *Albatross* station 5621 (0° 15′ 00″ N.; 127° 24′ 35″ E.)

The material includes typical specimens from the East Indian Islands, south of the Philippines, and, in addition to these, specimens from the Tawi Tawi Archipelago, which seem to be intergrading to-

[1] The measurements which Weber gives of two specimens and his count of 8 ventral rays indicates that he had this small eyed subspecies rather than *H. s. striatissimus* or *H. s. torvus*

ward *H. s. torvus*. Both sets are discused under the present heading. The stations at which each were taken are given separately in the following lists:

List of typical specimens.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° F.	
5626	Between Gillolo and Kayoa Islands	265		1
5625	do	230		5
5621	Between Gillolo and Makyan Islands	298		38
[1] 5593	Vicinity of Sibuko Bay, Borneo	[1] 38		1
5590	do	310	44.3	1
5589	do	260	45.7	26

[1] The tag borne by this specimen (No. 4540) corresponds to station 5593, but it is almost certain that an error has crept in here, as the species probably never lives in such shallow water; it is probable that the specimen was obtained at one of the deeper hauls earlier in the same day.

List of specimens varying toward H. s. torvus.

			° F.	
5172	Vicinity of Jolo Island	318		33
5173	do	186		1
5549	do	263	52.3	1
5550	do	258	52.3	1
5551	do	193	53.3	2
5563	Between Jolo and Tawi Tawi	224	52.3	7
5564	do	236	52.3	5
5565	do	243	52.3	2
5566	do	244	52.5	1
5576	North of Tawi Tawi	277	53.3	1

The distinctive characters of this subspecies are given under the heading of *Hymenocephalus striatissimus*. In other respects the description of this form will apply very well to either of the two other subspecies, *torvus* and *striatissimus*. The following description is based only on the typical series.

The body is robust anteriorly, becoming rather suddenly constricted and then attenuate behind into a whip-like tail; the length of the head is contained 6.32 times in the total length. The head approaches a rectangular outline, when viewed from above, before, or from the side; it is notably compressed, the greatest width being equal to its postorbital length. The snout is short and blunt, scarcely projecting beyond the mouth, 3.7 (to 4.5) in head. The middle of the length of head lies immediately behind the pupil; the same sometimes holds true in *striatissimus*. The orbit is obliquely oval; its greatest length, 2.8 in head, 1.3 in postorbital, varying from 1.15 to 1.4 (0.9 to 1.1 in typical *striatissimus*). Interorbital width about equal to length of orbit (decidedly less in *striatissimus* proper). As in *torvus* and *striatissimus*, the suborbital is somewhat narrower than the pupil (about two-thirds length of pupil in the type of *torvus*). The vertical from the hind margin of the maxillary passes through the eye behind the pupil. The barbel is shorter than the pupil in the type-specimen, but is usually longer; the variation of its length, as compared with the same measurements of the other subspecies.

has already been given. The teeth, of small size, are crowded into narrow bands on the jaws.

The fins are essentially like those of the other forms, the chief difference being in the number of ventral rays, which is 8 (7 in *torvus*); 127 fins were counted, of which 125 had 8 rays; the two fishes with 7 rays in one ventral had 8 rays in the other. The lengths of the various fins, when entire, are given in the table of proportional measurements. The base of the pectoral lies between the verticals from the origin of the dorsal and the base of the ventral.

Coloration in alcohol: brown on the trunk, becoming much darker near the front of the first dorsal fin and near the occiput; the tail is light yellowish, with traces of a median silvery streak; the middle of the sides of the trunk is silvery; the belly is underlain with darker,

FIG. 32.—HYMENOCEPHALUS STRIATISSIMUS AEGER. TYPE.

but superficially is silvery behind the ventrals and coppery before them. The region of the belly, extensively striated, is separated from the sides by a dark line, which extends from the blackish streak at the pectoral base to the anus; this dark line lies over the postclavicle. Below this streak the skin becomes more leathery than elsewhere, and is marked by a pattern of "striae," consisting of fine parallel and alternating lines of purplish black and silvery color connected with structural modifications. The lines are vertical (or transverse below) along the sides of the isthmus and backward to the ventrals and thence upward on the face of the shoulder girdle to before the pectoral fins, and backward almost to the anus. The striae in a small patch inward and forward from the ventrals are irregularly arranged, like the papillary ridges on one's fingers. Toward the mid-ventral line behind the ventral fins the striae become longitudinal. A squarish region before the ventrals, the center of which is located at the anterior lens-shaped organ, is devoid of striae. The gular membranes, as in the other subspecies of *striatissimus* and as in *long-*

iceps and *longipes*, are marked by two types of striae: the typical striation is fine and irregular, and in addition to this there occur coarser black cross lines. The black ring about the anus, surrounding also the posterior lens-shaped organ, is continued forward to and about the smaller anterior organ.

The cheeks and the surface of the preopercular region are brilliantly silvery; the opercle is dark, but with metallic luster: the ventral half of the suborbital region and the space between the eyes show a blackish color through the delicate superficial membranes. The snout, between and before the nostrils, is translucent; the mandible is mostly dark, but whitish along the lower lip; the end of the maxillary is also whitish. The extreme whitish margin of the buccal cavity lies just behind a dark area; the roof of this cavity is silvery, but the tongue is whitish, as is also the region before it, with the exception of a median black triangle, pointed forward; the branchial cavity is dark brown on its roof, and whitish on its lower sides, but margined by a blackish band with an extreme whitish edge on the opercular and branchiostegal membranes. The parietal peritoneum is purplish brown, underlain with silvery.

The vertical fins are usually clear, with a spot at the base of each ray, but the first anal ray and the dorsal spines are sometimes blackish; the distal half of the first dorsal fin is sometimes dusky, as in the type of *torvus*.

The specimens from the Tawi Tawi Archipelago, which are regarded as intergrades between *aeger* and *torvus*, agree with the preceding description in all characters but those showing intergradation toward *torvus*, as has already been discussed.

Table of measurements in hundredths of length to anus (typical specimens of H. s. aeger).

Albatross station	5621	5621	5621	5621	5589	5589
Total length in mm	165	145				
Length to anus in mm	39	36	42	36	37	39
Length of head	64	62	64	64	67	62
Length of orbit	22	23.5	22	25	25	25
Width of interorbital	21	22	21	21	22	21
Orbit to preopercle	30	30	29	27	30	29
Width of suborbital	9	9	9	7	10	9
Length of snout	18	19	14	17	19	18
Length of upper jaw	32	34	35	37		
Length of barbel	11	9	9	14	13.5	9
Depth of body	49	45	48	47		
Width of body	30	22	27	32		
Height of second dorsal spine		42				
Height of first dorsal base	21	22	23	23.5		
Interdorsal space	55	61	52	53		
Height of first anal ray				20		
Length of first pectoral ray	2	3				
Length of second pectoral ray			38	39		
Length of third pectoral ray			41	41		
Length of outer ventral ray				52	58	48
Length of second ventral ray		32		31		
Soft rays, first dorsal	8	8	9	9		
Ventral rays	8	8	8	8		
Pectoral rays	13	15	15	13		
Gill-rakers, lower limb, second arch	19	18	19	19	18	17

(*aeger*, feeble.)

51. HYMENOCEPHALUS GRIMALDII Weber.

Hymenocephalus grimaldii WEBER, Fische der *Siboga*-Expedition, 1913, p. 169, pl. 1, fig. 1.

This species seems to be a close ally of *H. striatissimus*, from which it differs in several characters: the eye is smaller, less than one-third length of head, and less than the interorbital width, which is wider, being two-fifths length of the head; the barbel is absent; there are only 10 pectoral rays.

These measurements and counts are taken from Weber's work, since the *Albatross* failed to obtain this species.

52. HYMENOCEPHALUS NASCENS, new species.

Hymenocephalus lethonemus WEBER, Fische der *Siboga*-Expedition, 1913, p. 167 (not of Jordan and Gilbert).

Type-specimen.—Cat. No. 78229, U.S.N.M., 143 mm. long to end of pseudocaudal, 47 mm. to anus; dredged at *Albatross* station 5587; depth, 415 fathoms; bottom temperature, 42.3° F.

The large number of specimens of the *lethonemus* type in the collection from the Philippine and East Indian Islands has made possible a very close comparison of them with typical *H. lethonemus* from Japan.[1] A single difference has been disclosed; namely, an increased average number of ventral rays. We regard *nascens* as a species rather than as a subspecies because there is no evidence at hand of the intergradation of the two forms. The number of ventral rays is summarized in the following table:

Number of ventral rays in Hymenocephalus lethonemus from Japan and in H. nascens from the Philippine and East Indian Islands.

	11	12	13
H. lethonemus	38	4	
H. nascens	9	103	2

The type-specimens of *H. lethonemus* also have 11 ventral rays; Weber gives 12 or 13 as the number of rays in the specimen of *nascens* which he referred to *lethonemus*. Most of the 9 fins of *nascens* with 11 rays are paired by a ventral with 12 rays.

[1] Jordan and Gilbert, Bull. U. S. Fish Comm., 1902 (1904), p. 615, text figure; Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 188.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5310	China Sea, vicinity of Hongkong	100	65.5	1
5114	China Sea and adjacent waters off southern Luzon	314	.....	1
5115 or 5116	....do	340 or 200	? or 50.2	1
5119	....do	394	43.7	1
5282	....do	248	47.4	7
5373	Vicinity of Marinduque Island	338	51.8	2
5445	East coast of Luzon	383	44.3	1
5510	Vicinity of northern Mindanao	423	53.0	1
5586	Vicinity of Sibuko Bay, Borneo	347	44.0	11
5587	....do	415	42.3	1
5589	....do	260	45.7	28
5622	Between Gilliolo and Makyan Islands	275	.....	3
5623	....do	272	.....	1
5624	....do	288	.....	7
Lost		.....	.....	1

From the data presented above it seems probable that this species inhabits water averaging deeper and colder than any other Philippine species of the genus, with the probable exception of *H. barbatulus*. The record from near Hongkong is unusual, and possibly erroneous.

The body is robust anteriorly, its greatest depth, below origin of first dorsal, being contained but 1.25 times in length of head; the paratypes, especially smaller ones, are more slender, the depth being contained from 1.35 to 1.5 times in head (2.0 times in *H. gracilis*). The lateral outlines of the head are strongly and evenly curved anteriorly; the sides of the head posteriorly are subvertical on the middle third, but are concave above and below. The width of the head is decidedly greater than its postorbital length. The snout projects horizontally forward from the vertical through front of premaxillaries a distance half as long as the pupil; the snout is a little shorter than the interorbital, its length is contained 1.25 (1.1 to 1.4) times in the orbit, and 3.8 (3.7 to 4.1) times in the head. The orbit is of irregular outline; its oblique length, which is the greatest, is contained 1.4 (1.3 to 1.5) times in the postorbital, or 3.0 (2.9 to 3.3) times in the total, length of head. The middle of the length of the head is midway between the hind margins of the pupil and of the orbit (varying to each of these limits in the paratypes). The least width of the interorbital space, contained 3.35 (3.0 to 4.0) times in the head, lies above the front of the pupil, from which place the sides of the interorbital diverge widely posteriorly; the least suborbital width is about equal to the diameter of the pupil. The length of the long and slightly oblique upper jaw is contained 1.9 (1.8 to 1.9) times in the head. The teeth are minute, and occur in narrow bands along the jaws. No trace of a barbel is developed. The angle of the preopercular ridge is sharp, but scarcely produced backward; the crenulate margin of the preopercle is evenly rounded. In the degree to which

the sensory canal system and thin bony septa of the head are developed, this species holds a position intermediate between *striatissimus* and its allies on the one hand, and *longiceps* and *longipes* on the other. The gill-membranes, which are free from the sides of the isthmus, unite, with a free fold, below the posterior margin of the orbit. The gill-rakers are arranged as in other species of the subgenus *Hymenocephalus;* there are two series of 18 on the lower limb of the outer arch; those of the outer series are decidedly more crowded and smaller than those of the inner series, as they are confined to the restricted limits of the first gill-slit, which is only about as long as the orbit. Seven branchiostegals.

The distance between the anus and the ventral base is equal to the distance from the tip of the snout to the hind margin of the orbit,

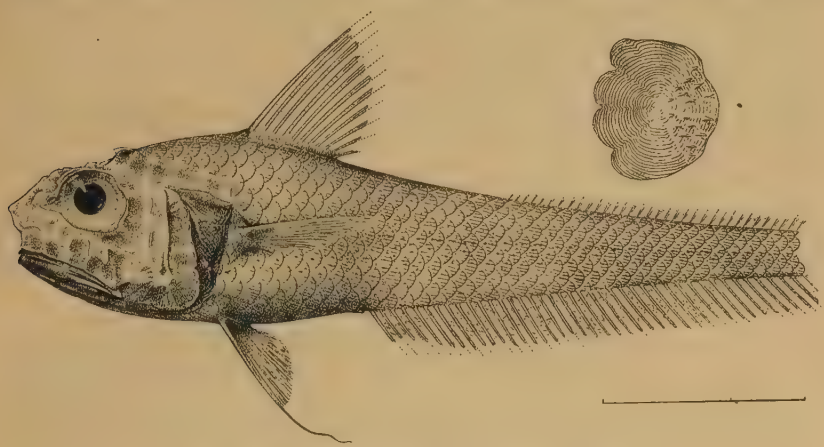

FIG. 33.—HYMENOCEPHALUS NASCENS. TYPE.

and about equal to the distance between the ventral base and the fold of the gill-membranes across the isthmus.

The ventral lens-shaped organs are both round; the diameter of the posterior of the two, although about twice that of the anterior one, is but one-fourth that of the pupil (half pupil in *longiceps* and *longipes*).

The few large scales retained on the side of the type bear 10 to 16 fine sharp spinules, directed backward, and arranged in quincunx order. The lateral line is rather poorly developed; it is separated from the first dorsal base by 2 rows of scales and from the front of the second dorsal by 4 rows.

No denticulations on the second dorsal spine are apparent. The length of the first dorsal base is contained 1.9 (1.5 to 2.1) times in the interval between the dorsal fins, and 1.2 (1.2 to 1.3) times in the postorbital length of the head. The length of the weak and slender pectoral fin is contained 1.6 (1.6 to 1.9) times in the head; the outer ventral ray, with its filament, 1.25 (1.1 to 1.3) times; the second ventral ray, 2.1 (2.0 to 2.35) times, barely reaching to the anus.

The color, darker in general than in most species of the subgenus, is purplish brown, becoming darker below the first dorsal fin; bluish black on the belly, chin, and opercles; and brownish black about the occiput. The lower sides of the trunk and the median strip of the tail are silvery, as are also the sides of the head. The upper parts of the head and the snout are translucent; the front margin of the snout is black; the inner wall of the suborbital cavity is dark ventrally. The roof of the buccal cavity is mainly silvery; the branchial cavity is lined with white, for the most part, but with black posteriorly on its outer sides (leaving the extreme rim of the branchiostegal and opercular membranes white); the parietal peritoneum is blackish, but underlain by silvery. The first dorsal fin is dusky, the anal lighter; the paired fins are light and clear, but with a black base which is preceded ventrally by an area with metallic luster; the base of each ray in the second dorsal and anal fins is marked by a black spot.

The striations are not so widely developed as in *striatissimus*, *longiceps*, *longipes*, and certain other species. The striated area extends backward from the ventral base about half way to the anus, and forward, from above the ventral base, along the sides of the isthmus. The striations are obsolete on and just below the pectoral base, immediately anterior to the ventral bases, and on the gular membrane, which, however, is crossed by the usual black lines not similar to the true "striae."

Table of measurements in hundredths of length to anus.

	H. lethonemus.				*H. nascens.*		
					Type.	Paratypes.	
Albatross station	4919	5060	4919	4919	5587	5114	5115 or 5116
Total length in mm	180+	[1] 122	[1] 182	[1] 177	[1] 143	152	160
Length to anus in mm	49.5	45	50	49	47	42	43
Length of head	67	63	67	65	63	66	64
Length of orbit	23	20	20	19	21	21	21
Width of interorbital	19	20	20	20	19	20	20
Width of suborbital	9	9	9	8.5	10	9	9
Orbit to preopercle	29	30	30	29	29	31	29
Length of snout	20	19	22	19	18	19	18
Length of upper jaw	35	33	36	34	34	38	36
Depth of body	45	40	40	43	45	45	48
Anus to ventral	.....	33.5	.....	.....	35	.....	.....
Ventral to gill-membrane	.....	37	.....	.....	36	.....	.....
Height of first dorsal base	23	22	26	24	26	27	27
Interdorsal space	42	37	38	47	49	42	41
Length of first pectoral ray	2	4	.....	.....	3	.....	.....
Length of second pectoral ray	40	37	35	33	33	.....	36
Length of third pectoral ray	40	40	38	35	36	.....	.....
Length of outer ventral ray	70	.....	59	.....	.....	59	.....
Length of second ventral ray	.....	30	30	28	29	.....	27
Soft rays, first dorsal	10	11	11	10	11	10	11
Ventral rays	12	11	11	11	12	11	12
Pectoral rays	13	13	15	16	17	15	15
Gill-rakers on lower limb of second arch	18	19	.....	.....	19	19	.....

[1] A pseudocaudal developed.

(*nascens*, being born, applied to this form to designate it as an incipient species.)

PAPYROCEPHALUS, new subgenus.

Type-species.—Hymenocephalus aterrimus Gilbert.

Three species of *Hymenocephalus* differs so widely from all others in certain characters that we have erected for them this new subgenus, *Papyrocephalus*. These species are *H. aterrimus* Gilbert[1] (Hawaiian), *H. papyraceus* Jordan and Gilbert[2] (Japanese), and *H. barbatulus*, new (Philippine). They are mutually characterized by their deep, sharply compressed bodies; by the excessive development of the shallow sensory canals of the head; by having the bony septa even much thinner and weaker than in typical *Hymenocephalus;* by the great width of the suborbital and preopercle; by the small eye; and by the blackish color, they being without the silvery sides characteristic of all other known forms.

53. HYMENOCEPHALUS BARBATULUS, new species.

Type-specimen.—Cat. No. 83652 U.S.N.M., 98 mm. long to end of tail, which is broken at its extreme tip, 27 mm. to anus; dredged with the single paratype 57 mm. long at *Albatross* station 5238, in

FIG. 34.—HYMENOCEPHALUS BARBATULUS. TYPE.

the Pacific Ocean, off the eastern coast of Mindanao; 380 fathoms; bottom temperature, 43.0° F.

Fin-rays—first dorsal, II, 8; pectorals, about 10; ventrals, 7 (11 in *papyraceus*, 13 or 14 in *aterrimus*).

The body is deep and compressed, tapering rather abruptly into the usual whip-like tail; greatest depth of body, 1.4 in length of head; greatest width of head, about equal to postorbital length of head. The head is bluntly rounded anteriorly, its lateral contours are subparallel. The length of the blunt snout is greater than that of the orbit, is nearly equal to the interorbital width, and is contained 3.3 times in the length of head. The orbit is small, being

[1] Gilbert, Bull U. S. Fish Comm., 1903 (1905), sec. 2, p. 666, pl. 93.
[2] Jordan and Gilbert, Bull. U. S. Fish. Comm., 1902 (1904), p. 614, text figure.

little wider than the suborbital; its length is contained two times in the postorbital, or four times in the entire length of the head. The middle of the length of the head lies between the hind margins of the pupil and of the orbit. The mouth is large, terminal, and oblique; the length of the upper jaw enters twice into the head. Fine teeth are arranged in very narrow bands on the jaws. The barbel is evident, but decidedly shorter than the pupil. The distance between the angle of the preopercular ridge and the margin of the preopercle is equal to the orbit. The sensory canals are much wider but shallower than in typical species of *Hymenocephalus;* the bones are excessively delicate and papery. The gill-membranes are free from the sides of the isthmus; the first gill-slit is less restricted than usual in this subfamily; about 13 short and spinous gill-rakers were counted on the first arch.

The anus is located immediately before the anal fin, at a distance from the ventral base contained 1.6 times in the head; this distance is decidedly longer than that from the tip of the snout to the hind margin of the orbit.

The lens-like structures on the midventral line are small; the one immediately in advance of the anus is double, consisting of two small closely connected hemispheres lying side by side, the division being more complete than in *striatissimus.*

The few scales retained are round and wholly spineless, as in *aterrimus*, *gracilis*, and *tenuis.*

Base of first dorsal fin, 1.7 in postorbital. The rays of the paired fins are weak (broken in types).

Color in alcohol: blackish on the head and trunk and on the first dorsal and the ventral fins, becoming brown on the tail, with a black spot at the base of each anal ray; the pectoral fin is dusky. The buccal cavity is black along the margins of the jaws, but light on the tongue and silvery on the roof of the cavity; the branchial cavity is lined with dusky, the peritoneal cavity with black (underlain with silvery).

The striated region is confined to the sides of the isthmus and to the area immediately above and behind the ventral fins.

This species is closely related to *H. aterrimus*[1] and to *H. papyraceus*[2] forming with them the group which we have just called *Papyrocephalus. H. barbatulus* agrees with *papyraceus* in the possession of a small barbel, which is lacking in *aterrimus.* The number of ventral rays serves to distinguish all three species: in *barbatulus* there are but 7; in *papyraceus*, 11; in *aterrimus*, 13 or 14.

(*barbatulus*, in reference to the short barbel.)

[1] Gilbert, Bull. U. S. Fish Comm., 1903 (1905), sec. 2, p. 666, pl. 93 (Hawaiian Islands).

[2] Jordan and Gilbert, Bull. U. S. Fish Comm., 1902 (1904), p. 614, text figure (Sagami Bay, Japan).

Genus MALACOCEPHALUS Günther.

For a description of this genus with a discussion of its relationships, and for a key to the four species it contains, reference may be made to our report on the macrouroid fishes in Japan.[1]

54. MALACOCEPHALUS LUZONENSIS, new species.

Malacocephalus, species, GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 189.

Type-specimen.—Cat. No. 83626 U.S.N.M., 56.5 mm. long to anus; dredged at *Albatross* station 5440.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5282	Off southern Luzon	248	47.4	2
5291	.....do	173	51.5	1
5440	Off western Luzon	172	53.2	Type.
5476	Off eastern Luzon	270	48.3	1

Fin-rays—first dorsal, II, 10; pectorals 16 or 17, ventrals, 9.

This species is characteristically blunt-headed; the greatest depth, between the vertical from front of first dorsal and that from the preopercular ridge, is contained 1.2 times in the head. The snout is unusually low and blunt, its bony tip is on a horizontal from the lower margin of pupil; preocular length of snout, 4.2 in head; preoral length, 3.7 in postorbital. The least interorbital width slightly exceeds the length of orbit. The ridge and margin of the preopercle are sharply produced backward at their angles; the least suborbital width is nearly equal to the diameter of pupil. The mouth is large and oblique; the length of the upper jaw, which extends backward well beyond the orbit, is contained 1.8 times in the head; the teeth are stronger than in the Japanese or Hawaiian species, the longest being about one-seventh as long as the orbit; the teeth are recurved, and are arranged in two series in the upper jaw, of which the outer row is enlarged, like the single series on the lower jaw. The barbel is long and slender, being contained 1.6 times in the orbit. The gill-membranes form a narrow free fold across the isthmus below the posterior margin of the orbit; this wide forward extension of the branchial aperture in *Malacocephalus* is evidence of relationships with *Hymenocephalus* and with *Ventrifossa*, the next genus to be described.

The scales are very small; about 13 series separate the prominent lateral line from the origin of the second dorsal; each scale is armed with about 10 small suberect spinules arranged in a diamond-shaped patch on each scale. The anterior curve of the lateral line is long and low. The gular membrane is naked; the branchiostegal membrane is scaled over the 7 rays.

[1] Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 136, 141, 189.

The pyloric caeca, as in the other Pacific species, are very numerous, and are branched. The center of the anus is placed well in advance of the anal origin, the interspace being about one-half of the distance between the anus and the ventral fin, or one-fifth the postorbital length of the head. There is a small naked fossa between the ventral fins.

The dorsal spine is without denticulations.

The color in alcohol is silvery gray, clearest along the middle of trunk and tail, becoming brownish on the back, dusky on the opercles and gular membranes, and blackish between the ventrals and the anus.

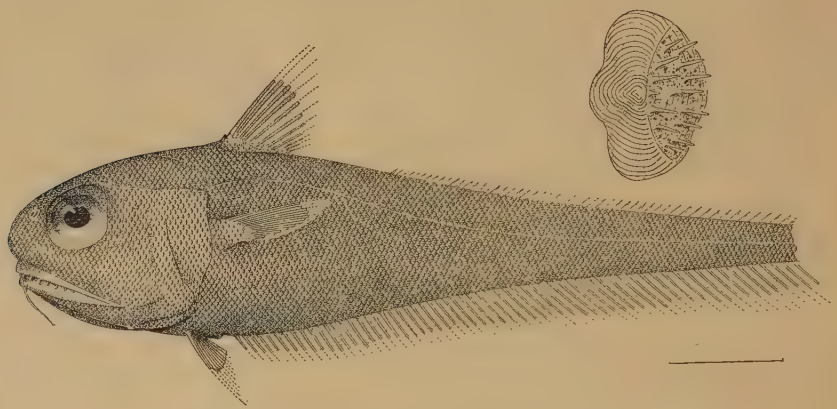

FIG. 35.—MALACOCEPHALUS LUZONENSIS. TYPE.

This species is well distinguished by its blunt, low snout, strong dentition, long barbel, uniform dusky fins, etc. In these diagnostic characters the four paratypes, which are in poor condition, agree with the holotype.

Table of measurements in hundredths of length to anus.

	Types.		Paratypes, *hawaiiensis*.		
	Luzonensis.	*Nipponensis.*			
Albatross station	5440	4967	4134	4134	4134
Total length in mm	.....	[1] 406	340+	330+	285+
Length to anus in mm	56.5	77	69	66	53
Length of head	89	92	85	84.5	86+
Length of orbit	29	30.5	31	29	31
Width of interorbital	31	32	26	28	29
Width of suborbital	10	11	10	9	9
Orbit to preopercle	44	42	37	36	39
Length of snout	21	27	23	24.5	24
Postorbital length of head	42	43	35	36	36.5
Length of upper jaw	48	47	40.5	40	42
Length of barbel	18	15	13.5	16	17
Depth of body	76	.....	74	71	84
Width of body	45	45	44	42.5	39
Anus to anal	9	17	7.5	10	9
Anus to ventral	15	17	17	17	16.5
Ventral to isthmus	35	34	29	30	27
Length of first dorsal base	22	26	26	24.5	28

[1] A pseudocaudal developed.

(*luzonensis*, from the type locality.)

55. ? MALACOCEPHALUS LAEVIS (Lowe).

Malacocephalus laevis WEBER, Fische der *Siboga*-Expedition, 1913, p. 166.

Doctor Weber has kindly reexamined his material for us, and has made some measurements on the head which indicate that his specimens are not referable to *M. luzonensis*. The measurements referred to are as follows:

Siboga station	38		38	314
Total length	300	mm.	321	283
Preocular length of snout	15.5	mm.	15	11
Preoral length of snout (from front of premaxillary)	12	mm.	12.5	13
Postorbital length of head	27	mm.	23.5	22

Whether these specimens are really referable to *M. laevis* is not evident. We have no specimens of that species.

VENTRIFOSSA, new genus.

Type-species.—Coryphaenoides garmani Jordan and Gilbert.

In the synopsis of the genera of Macrouroid fishes, which was included in our report on the fishes of this family from Japan,[1] we separated out a group of species [2] (*e*) distinguished by the number of branchiostegal rays (seven), and by the position of the anus (remote from the anal fin). The genus *Malacocephalus* was next separated from the other genera: *Lionurus*, *Mataeocephalus*, *Trachonurus*, and *Cetonurus*. But in the description of *Lionurus* [3] it was noted that nine species differed widely from the others, but closely resembled *Malacocephalus* in the large subterminal mouth and other characters. These species, together with two new ones which we are describing in this report, further agree with *Malacocephalus* in the ventrolateral extension of the gill-slit, which is continued forward to below the posterior rim of the orbit. In *Cetonurus*, *Trachonurus*, and *Mataeocephalus*, as well as in the other species which we referred to *Lionurus*, the gill-membranes unite below the ridge of the preopercle or thereabouts, except in certain aberrant species like *pumiliceps*, in which the whole ventral region of the head and trunk has migrated forward, producing a very peculiar physiognomy.[4] In all the species of *Malacocephalus* and *Ventrifossa* the length of the upper jaw is contained decidedly less than 3 times in the head, while in all other species in the group of genera under discussion, the length of the upper jaw is contained about three times (*Lionurus stelgidolepis*, *Trachonurus villosus*) or more than three times (usually much more) in the head.

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[1] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 135 to 214.

[2] In the listing of the species we erroneously referred to *V. nigromarginata* as *L. nigromaculatus*.

[3] Proc. U. S. Nat. Mus., vol. 51, 1916, p. 192.

[4] Owing to the intermediate position of several species, we are unable to define or delimit a group based on *pumiliceps* and its nearest allies.

There can be little question as to the naturalness of this group of species, although they have been described as members of the following diverse genera: *Macrourus*, *Optonurus*, *Malacocephalus*, *Coryphaenoides*, *Chalinura*.

KEY TO THE SPECIES OF VENTRIFOSSA.

a^1. A scaleless ventral fossa, not pearly, nor lens-like, situated between the ventral fins, of variable size, and usually separated by a more or less complete scaly bridge from the peritroct; mouth little oblique; spinules on scales arranged in quincunx order.

b^1. Teeth of lower jaw in two series; canines of upper jaw arrow-shaped; denticulations of dorsal spine obsolescent; scales with a few short spinules; orbit about 3 in head_____(ATHERODUS, new subgenus.) *atherodon.*[1]

b^2. Teeth of lower jaw in three or more series, forming a narrow band; denticulations of dorsal spine numerous and sharp; scales beset with numerous spinules_____(Subgenus VENTRIFOSSA.)

c^1. Sides of head and body brownish, with little or no silvery; scales small.

d^1. Preopercle not produced backward at its angle; outer ventral ray filamentous; upper jaw shorter, its length $2\frac{2}{3}$ in head__*macronemus.*

d^2. Preopercle produced backward at its angle; outer ventral ray not filamentous; upper jaw longer, its length $2\frac{1}{3}$ in head_____*misakia.*

c^2. Sides of head and body bright silvery; scales of moderate size.

e^1. An area of enlarged spineless scales behind first dorsal; eye about 4 in head; 6 rows of scales from last ray of first dorsal to lateral line; first dorsal black, with a white base and tip (Alcock). *petersonii.*

e^2. No area of enlarged or spineless scales behind first dorsal fin; orbit 3.5 in head, or larger.

f^1. Preopercular ridge not sharply produced backward.

g^1. First dorsal fin with a distinct black spot; ventrals blackish.

h^1. Ventral fossa very small, as in *garmani*, its front being behind the bases of the outer ventral rays; barbel about $\frac{2}{3}$ as long as the snout_____*nigrodorsalis.*

h^2. Ventral fossa of moderate size, its front being in line with the outer ventral rays_____*ctenomelas.*

g^2. First dorsal fin without a distinct black spot; ventrals paler; ventral fossa small; barbel longer than the snout, being contained 2.8 to 4.0 times in the head.

i^1. 7 to 9 series of scales separating the front of second dorsal from lateral line row; interorbital width less (0.20 to 0.23, usually 0.21 or 0.22 of length to anus_____*divergens.*

i^2. 6 series of scales above lateral line; interorbital wider (0.22 to 0.29, usually 0.25 to 0.27 of length to anus)_____*garmani.*

f^2. Preopercular ridge sharply produced backward at its angle. *occidentalis.*

a^2. A lens-like organ immediately before anus, and another between the ventrals, much as in *Hymenocephalus;* mouth little oblique; spinules on scales arranged along parallel series_____LUCIGADELLA, new subgenus.) *nigromarginata.*

[1] This species approaches the genus *Malacocephalus* most closely.

a^3. A conspicuous pearly body in a sheath between the ventrals; mouth notably oblique, spinules on scales arranged in quincunx order (LUCIGADUS, new subgenus) ..... *lucifer.*

Three species, *atherodon*, *nigromarginata*, and *lucifer* are sharply distinguished from the others, and may serve as the respective types of the new subgenera *Atherodus*, *Lucigadella*, and *Lucigadus*.

(*Ventrifossa*, in reference to the scaleless fossa present in the typical species between the ventral fins.)

Subgenus VENTRIFOSSA Gilbert and Hubbs.

56. VENTRIFOSSA MACRONEMUS Smith and Radcliffe.

Macrourus macronemus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., Vol. 43, 1912, p. 115, pl. 24, fig. 3.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5114	Off southwestern Luzon	340		1
5424	Jolo Sea, near Cagayan Islands	340	50.4	Type.
5528	Between Siquijor and Bohol Islands	439	53.3	1

This species is related most closely to *V. misakia*, of Japan and the east coast of Luzon.

(*macronemus*, in reference to the produced outer ventral ray.)

57. VENTRIFOSSA MISAKIA (Jordan and Gilbert).

Coryphaenoides misakius JORDAN and GILBERT, Bull. U. S. Fish. Comm., 1902 (1904), p. 611, text fig.

Lionurus misakius GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 194.

Macrourus asper JORDAN and THOMPSON, Mem. Carnegie Mus., vol. 6, pt. 4, 1914, p. 306, pl. 38, fig. 2 (not *Coryphaenoides asper* Günther).

A single specimen of this well-marked species, hitherto known only from Japan, was collected during the Philippine cruise; it was dredged at *Albatross station* 5445, off the southeastern coast of Luzon; depth, 383 fathoms; bottom temperature, 44.3° F.

Dorsal rays, II, 10; ventral rays, 8.

We compare this specimen in the following table with two, including the type, from Japan. Certain differences are indicated which render somewhat doubtful the reference of our specimen to *V. misakia*. The snout is longer; the barbel much longer; the distances greater between the anus and the origin of the anal fin and between the ventral base and the isthmus.

Table of measurements in hundredths of length to anus.

	Eastern Luzon.	Japan.	
Albatross station	5445	Type.	.....
Total length in mm	170+	340+	113+
Length to anus in mm	36	80	30
Length of head	92	85	90
Length of orbit	36	30	41
Width of interorbital	28	28	29
Width of suborbital	13	10	12
Orbit to preopercle	39	38.5	37
Length of snout	26	21.5	.....
Length of upper jaw	37	35	38
Length of barbel	10	4	4
Depth of body	62	63	62
Width of body	32	36	28
Anus to anal	17	11.5	13
Anus to ventral	12	11.5	13
Ventral to isthmus	30	28	26
Length of first dorsal base	22	22.5	22
Interdorsal space	33	37	.....

(*misakius*, from the type locality.)

58. VENTRIFOSSA NIGRODORSALIS, new species.

Type-specimen.—Cat. No. 83627, U.S.N.M.; 214 mm. long, 45.5 mm. to anus; *Albatross* station 5502, off the northern coast of Mindanao; depth, 214 fathoms.

List of paratypes.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5317	China Sea, vicinity of Formosa	230	50.6	1
5113	China Sea, off southern Luzon	159	.....	1
5122	East coast of Mindoro	220	.....	6
5124	.....do	281	.....	6
5172	Vicinity of Jolo	318	.....	2
5198	Vicinity of western Bohol	220	53.9	1
5221	Between Marinduque and Luzon	193	52.4	6
5222	.....do	195	52.8	11
5259	Off northwestern Panay	312	49.3	1
5348	Palawan Passage	375	56.4	1
5363	Balayan Bay, southern Luzon	180	.....	8
5365	.....do	214	.....	5
5374	Vicinity of Marinduque Island	190	.....	11
5388	Between Burias and Luzon	226	51.4	6
5404	Vicinity of Dupon Bay, Leyte	190	54.4	1
5406	.....do	298	.....	2
5409	Between Cebu and Leyte	189	.....	12
5444	East coast of Luzon	308	45.3	2
5445	.....do	383	44.3	2
5501	Vicinity of northern Mindanao	214	54.3	5
5502	.....do	214	.....	14
5503	.....do	226	53.3	8
5504	.....do	200	54.3	6
5505	.....do	220	.....	5
5508	.....do	270	53.3	6
5523	.....do	.....	.....	1
5535	Between Cebu and Siquijor	310	53.3	2
5536	Between Negros and Siquijor	279	53.5	4
5538	.....do	256	53.3	1
5542	Vicinity of northern Mindanao	200	54.3	3
5586	Vicinity of Sibuko Bay, Borneo	347	44.0	3
5587	.....do	415	42.3	2
5589	.....do	260	45.7	4
5590	.....do	310	44.3	3
5592	.....do	305	43.3	2
5622	Between Gillolo and Makyan Islands	275	.....	2
5624	.....do	288	.....	5
5625	Between Gillolo and Kayoa Islands	230	.....	7

In both its geographical and its bathymetric distribution, *V. nigrodorsalis* agrees with the following species, *V. divergens.*

Fin-rays—first dorsal, II, 10 (9 to 11); pectorals, 20 (17 to 23); ventrals, 8 (8 or 9).

The body is deeper than in *V. divergens*, the ventral contour being more strongly arched; the depth below the elevated origin of the first dorsal fin is contained 1.1 times in the head, being more than twice the greatest width of the body. The general appearance of this species in other respects strongly resembles that of *divergens.* The horizontal projection of the snout beyond the premaxillaries is equal to the length of the pupil; preocular length of snout, 3.7; pre-

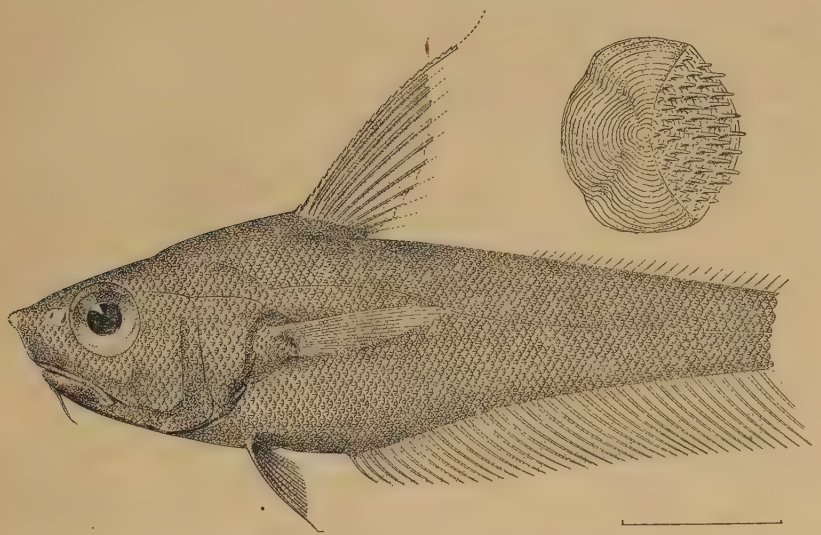

FIG. 36.—VENTRIFOSSA NIGRODORSALIS. TYPE.

oral length, 2.6 in postorbital. The orbit is almost round, 3.4 in head, 1.6 in postorbital. The interorbital is rather narrow, as in *divergens* as contrasted with *garmani;* its least width is contained 1.25 times in the orbit, 2.0 times in the postorbital. The oblique preopercular ridge is not produced backward at its angle. The suborbital width is nearly equal to the diameter of the pupil. The mouth is little oblique and large, the maxillary extending backward almost to the vertical from the posterior margin of the pupil; length of upper jaw, 2.6 in head. The teeth are apparently finer than in *divergens;* the outer premaxillary series is little enlarged. The barbel is well developed but comparatively short, being constantly shorter than in *divergens;* its length is about two-thirds that of the snout. The branchial aperture extends forward to below the hind margin of the orbit; seven branchiostegals.

The scales bear numerous fine spinules close-set in quincunx order. There are 8 (7 to 9) rows between the origin of the second dorsal and the lateral line series.

The anus is situated just behind the ventral fins. A small fossa, about 1 mm. broad, lies between the middle of the ventral bases, being much smaller than in *V. ctenomelas*.

The numerous sharp denticulations of the second dorsal spine are developed along its entire length. The ventral fin is inserted a little in advance of the pectoral. The right pectoral fin of the type-specimen is absent, apparently as the result of an early injury; its base is now completely healed over and covered by small scales.

The color in alcohol, a little darker than in *V. divergens*, is brown, becoming darker and more dusky below the first dorsal fin, and blackish on the belly; the sides shine with silvery reflections. The ridges and margins of the head are mostly dark; the jaws are whitish at the corners of the mouth. The first dorsal fin is dusky, with an intensely black median spot; the pectoral is dark dusky, becoming black on its base and axil; the ventral is blackish, but sometimes lighter either proximally or distally. The lining of the buccal cavity is whitish; that of the branchial cavity is dusky anteriorly, whitish over most of the hyoid region, and blackish within its posterior outer margin, except on the extreme white edge. The parietal peritoneum is silvery, with fine black dots.

The relationships of this species are indicated in the key which is included under the generic heading.

Weber [1] reported on some specimens of this group, referring them to *Macrurus petersoni* Alcock. He distinguished two sets of specimens; the typical ones are probably true *V. petersonii*, but his variants are more probably referable to *V. nigrodorsalis*.

Table of measurements in hundredths of length to anus.

	Paratypes.						Type.
Albatross station	5317	5586	5586	5586	5542	5330	5502
Total length in mm.	192	240	[2] 220	[2] 188	[2] 171	187	214
Length to anus in mm.	38	53	51	49	39	37.5	45.5
Length of head	85	82	84	85	82	92	90
Length of orbit	29	26	24	27.5	26	31	27
Width of interorbital	23	23	23	21	22	24	21
Width of suborbital	10	11	11	11	10	12	11
Orbit to preopercle	33	33	35	33	35	38	38
Length of snout	22	24	26	26	23	27	26
Length of upper jaw	32	34	34	33	30	37	35
Length of barbel	21	18	20	21	18	18	17
Depth of body	76	68	77	68	69	77	81
Width of body	30	34	29	35	32	35	41
Anus to anal	12.1	17.5	18	16	12.5	13	22
Anal to ventral	23	29	27	26	23	22	33
Height of second dorsal spine	73	69	.....	72	65	79	.....
Height of third dorsal ray	.....	63	56	70	63	76	.....
Length of first dorsal base	23	25	23	23	22	26	26

[1] Fische der *Siboga*-Expedition, 1913, p. 156.

[2] A pseudocaudal developed.

Table of measurements in hundredths of length to anus—Continued.

	Paratypes.						Type.
Interdorsal space	57	57	60	58	53	.....	60
Height of second dorsal	.....	15	13	.....	.....	.....	.....
Length of first pectoral ray	9	10	9	7	7	5	11
Length of second pectoral ray	49	49	43	48	45	.....	48
Length of pectoral fin	50	51	49	54	49	53	62
Length of outer ventral ray	33	40	41	45	33	42	37
Length of second ventral ray	30	32	31	31	26	.....	32
Soft rays, first dorsal	10	11	10	10	11	9	10
Ventral rays	9	9	9	9–8	8	8	8
Pectoral rays	20	23	20	20	17	18	20
Scales above lateral line	8	8	8	7	9	8	8
Denticulations of dorsal spine	36+?6	29	.....	29	26	48	.....
Gill-rakers, lower limb, second arch	11	13	12	12	.....	11	11

(*nigrodorsalis*, in reference to the black spot on the first dorsal fin.)

59. VENTRIFOSSA DIVERGENS, new species.

Type-specimen.—Cat. No. 78230, U.S.N.M.; 270 mm. long to end of tail, 54 mm. to anus; dredged at *Albatross* station 5592, in the vicinity of Sibuko Bay, Borneo (lat. 4° 12′ 44″ N.; long. 118° 27′ 44″ E.); depth, 305 fathoms; bottom temperature 43.3° F. The largest paratypes are about 66 mm. long to anus.

List of paratypes.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5310[1]	China Sea, vicinity of Hongkong	100	65.5	1
5325	Off northern Luzon	224	53.2	2
5329	do	212	51.4	1
5259	Off northwestern Panay	312	49.3	1
5269	Off southwestern Luzon	220	.....	2
5282	do	248	47.4	2
5284	do	422	42.3	1
5289	do	172	.....	16
5290	do	214	.....	7
5293	do	180	57.4	3
5294	do	244	48.4	3
5296	do	210	.....	3
5297	do	198	.....	2
5444	Off eastern Luzon	308	45.3	2
5590	Vicinity of Sibuko Bay, Borneo	310	44.3	1
5621	Between Gillolo and Makyan Islands	298	.....	12

[1] The shallowness and warmth of the water at this station (5310) is unusual for this species, as well as for *Hymenocephalus nascens*.

Fin-rays—first dorsal, II, 9 (3 specimens), II, 10 (15), or II, 11 (8); pectorals, 23 (to 21); ventrals, 8 (11 fins) or 9 (9 fins).

The greatest depth of the body lies below the elevated origin of the first dorsal fin, and is contained 1.25 times in the head; the greatest width of the body is half its depth. The snout is broadly triangular when viewed from above; viewed from the side it is seen to project forward beyond the mouth a distance equal to the diameter of the large pupil; preocular length of snout 3.8 in head; the pre-

oral length is one-third the postorbital. There are no enlarged median nor lateral rostral tubercles. The large orbit is slightly oval in outline; its length, greater than that of the snout, is contained 3.22 (2.9 to 3.4 in 14 paratypes) times in the head, 1.4 times in the postorbital. The least width of the flat interorbital space is contained 1.2 times in the orbit, or 1.8 times in the postorbital; the interorbital is narrower than in the closely related Japanese species, as the following figures indicate:

Table to show least width of interorbital space in hundredths of length to anus.

	20	21	22	23	24	25	26	27	28	29
V. garmani			2	2	2	4	4	8	2	1
V. divergens	1	3	4	2						

The ridge and the margin of the preopercle extend downward and backward, but are not sharply produced backward behind their general courses at their angle. The suborbital width is narrower than the pupil. The mouth is very large and a little oblique; the length of the upper jaw, which extends backward a little farther than the orbit, is contained 2.3 times in the head. The rather coarse teeth are arranged in narrow bands on the jaws; the outer premaxillary series is enlarged. The barbel is long and slender, being nearly as long as the snout in the type, but usually decidedly longer in the paratypes; its free length is contained about four times [1] in the head, but varies in the paratypes as indicated in the following table:

Table showing the length of the barbel in V. divergens as measured into the head.

Length of barbel	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0
Number of specimens	5	1	1	3	5	1	1	--	1	1	--	1	1

The sensory canal system of the head is well developed, much as in *Hymenocephalus*, but the membranous roofs over the canals are thicker and are covered by firm scales, and the bony septa supporting these membranes are stronger. The branchial aperture is extended forward to below the hind margin of the orbit. The 13 to 15 short, spinous gill-rakers are better developed than usual in the Coryphaenoidinae, but are not so numerous as usual in the species of *Hymenocephalus*. Seven branchiostegals.

The scales, which are beset with numerous fine spinules arranged in quincunx order, are more numerous than in *V. garmani*, which

[1] Possibly when shortest the barbel has been injured some time during the life of the individual.

has but six rows between the lateral line series and the front of the second dorsal; in *divergens* there are 7 to 9 rows (7 in 2 specimens, 8 in 13, 9 in 7). The gular and branchiostegal membranes are scaleless.

The anus is located just behind the ventral fins; it is preceded, after a scaly interspace, by a very small naked spot or fossa like that of *garmani* and *nigrodorsalis*.

The numerous and fine denticulations of the second dorsal spine are sometimes obscure proximally. The bases of the pectoral and ventral fins are on the same vertical in the type, but in some speci-

FIG. 37.—VENTRIFOSSA DIVERGENS. TYPE.

mens the ventral is inserted a little farther forward. The second ventral ray extends to the origin of the anal fin.

Color in alcohol, silvery on the sides; brown on the back, becoming darker anteriorly; blackish on the under surface of the trunk and head, and on the jaws, which, however, are whitish about the corners of the mouth. There is a dark streak along the front margin of the snout, and another at the occiput. The first dorsal fin is dusky proximally, but lacks the deep black spot of *nigrodorsalis* and *petersonii;* the base and axil of the pectoral fin are black; the ventral fin is almost black in the type and in some paratypes, but usually is dusky, becoming blackish proximally. The lining of the buccal cavity is mostly whitish; that of the branchial cavity mostly blackish brown, but whitish over most of the hyoid arch and on the extreme free edge of the branchiostegal and opercular membranes. The parietal peritoneum is silvery, with brownish spots.

Table of measurements in hundredths of length to anus.

Albatross station	5284	[2] 5592	5269	5115 or 5116	5290
Total length in mm	285	272	.....	222	302
Length to anus in mm	62.5	55	52	48.5	66
Length of head	86	88	82	86	83
Length of orbit	26	27.5	27	28	27
Width of interorbital	23	21.5	21	22.5	22
Width of suborbital	11	10	11	12	10.5
Orbit to preopercle	38	40	38	39	37
Length of snout	24	25	21.5	24	21
Length of upper jaw	40	40	39	40	39
Length of barbel	30	24	28	23	27
Depth of body	76	75	.....	79	73
Width of body	37	40	.....	30	.....
Anus to anal	19	16	.....	20	14
Height of second dorsal spine	.....	.....	.....	.....	57+
Height of third dorsal ray	.....	.....	.....	.....	55+
Length of first dorsal base	25	26	24	26	25.5
Interdorsal space	48	52	51	50	45.5
Length of first pectoral ray	7	4	8	7	5.5
Length of second pectoral ray	38	49	.....	.....	.....
Length of pectoral fin	49	58	.....	.....	.....
Length of outer ventral ray	.....	41	.....	.....	.....
Length of second ventral ray	.....	29	.....	.....	.....
Soft rays, first dorsal	9	10	11	10	11
Ventral rays	8	8	9	8	9
Pectoral rays	21	23	20	19	19
Scales, above lateral line	7	8	8	8	9
Gill-rakers, lower limb of second arch	13	.....	.....	15	13

[2] Type-specimen.

(*divergens*, diverging, that is, from *V. garmani*, its representative in Japan.)

LUCIGADELLA, new subgenus.

60. VENTRIFOSSA NIGROMARGINATA (Smith and Radcliffe).

Macrourus nigromarginatus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 114, pl. 24, fig. 2.

Lionurus nigromaculatus GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916. pp. 145, 192 (misprint).

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5135	Vicinity of Jolo	161	57.4	2
5172	....do	318	.....	2
5198	Vicinity of western Bohol	220	53.9	1
5260	Off southeastern Mindoro	234	51.4	2
5261	....do	145	.....	1
5265	Off southwestern Luzon	135	.....	1
5388	Between Burias and Luzon	226	51.4	7
5418	Between Cebu and Bohol	159	54.4	1
5501	Vicinity of northern Mindanao	214	54.3	3
5502	....do	214	.....	1
5505	....do	220	.....	1
5508	....do	270	53.3	1
5516	....do	175	54.3	6
5517	....do	169	54.3	1
5518	....do	200	54.0	2
5519	....do	182	54.3	3
5523	....do	.....	.....	3
5527	Between Siquijor and Bohol	392	53.3	1
5551	Vicinity of Jolo Island	193	53.3	1
5565	Between Jolo and Tawi Tawi	243	52.3	1
5569	North of Tawi Tawi	303	52.3	1
5575	....do	315	52.3	1
5576	....do	277	53.3	1
5580	Vicinity of Darvel Bay, Borneo	162	55.8	1
5661	Flores Sea (5° 49′ 40″ S.; 120° 24′ 30″ E.)	180	50.5	1

In its distribution this species closely parallels *V. nigrodorsalis;* the two species were often dredged together.

Among the diagnostic characters of this species the coloration, the parallel arrangement of the spinules on the scales, and the presence of two lens-like organs may be mentioned. The lens-like structures closely resemble those of *Hymenocephalus:* the smaller one lies between the ventral fins, the larger one is situated in a naked area immediately before the anus.

(*nigromarginatus*, having a black margin along the anal fin anteriorly.)

LUCIGADUS, new subgenus.

61. VENTRIFOSSA LUCIFER (Smith and Radcliffe).

Macrourus lucifer SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 113, pl. 24, fig. 1.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5268	Off southwestern Luzon	170		1
5516	Off northern Mindanao	175	54.3	[1] 4
5517	do	169	54.3	1
5519	do	182	54.3	8

[1] One of these specimens (Cat. No. 72929, U. S. N. M.) is the type of the species.

This species is one of the most distinct in the entire subfamily. The conical pearly structure directed downward and forward, and ensheathed in the ventral abdominal wall, is highly diagnostic.

The possibility that this organ is phosphorescent led to the naming of this species *lucifer.*

Genus LIONURUS Günther.

Lionurus GÜNTHER, *Challenger* Reports, vol. 22, Deep-Sea Fishes, 1887, pp. 124, 141.—GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 192.

The genus *Lionurus* is here used as we have already modified and defined it,[1] exclusive of those species which are now referred to *Ventrifossa*, a genus which we have just described. As all of the Philippine species have spinous scales, they are all referred to the subgenus *Nezumia.*

[1] Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 141, 192.

Subgenus NEZUMIA Jordan.

62. LIONURUS PROXIMUS (Smith and Radcliffe).

Macrourus proximus SMITH and RADCLIFFE, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 119, pl. 26, fig 2.

Lionurus proximus GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol 51, 1916, p. 201.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5201	Off southern end of Leyte Island	554	52.8	1
5202	....do	502		Type.
5527	Between Siquijor and Bohol Islands	392	53.3	1

We have already recorded this species from Japan, referred it to its proper position, and given measurements, in hundredths of length, of both the Japanese and the three Philippine specimens.

(*proximus*, from its supposed close relationship with *Coryphaenoides nasutus*.)

63. LIONURUS SPINOSUS Gilbert and Hubbs.

Lionurus spinosus GILBERT and HUBBS, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 199, pl. 10, fig. 2.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Number of specimens.
5463	Off the eastern coast of Luzon	300	1
5470	....do	560	3

These four specimens are probably the young of *L. spinosus*, described originally from Japan. The head is proportionally longer and the body deeper than in the larger Japanese type; the difference is wider than that which usually results from age-variation, and it is quite possible that two species are represented. The differences, however, may to a certain extent be more apparent than real, as the larger measurements of the Philippine specimens may result from the smaller base of measurements (length to anus) due to the position of the anus.

Table of measurements in hundredths of length to anus.

	Philippine Islands.				Japan.
Albatross station	5470	5463	5470	5470	4915
Total length in mm	196	[1] 165		[1] 150	280
Length to anus in mm	33	45	42	38	64.5
Length of head	90	91	86	91	73
Length of orbit	29	25	24	27	20
Width of interorbital	18	17	14	15	15.5
Width of suborbital	9	9	9	10	9
Orbit to preopercle	30	29	31	29	24
Length of snout	26	22	22	23	22
Length of upper jaw	26	22		22	22
Length of barbel	10	12	9	10	10
Depth of body		79	60	71	56
Anus to anal	22	17	21	18	13.5
Height of second dorsal spine		81		95	96.5
Height of third dorsal ray				68	68
Interdorsal space	34		32	32	27
Length of pectoral	47	43	41	41	37
Length of outer ventral ray	68			66	40
Length of second ventral ray	30	26			22
Soft rays, first dorsal	9	10	10	9	10
Ventral rays	8	9	8	8	8
Pectoral rays	21	20	19	22	21
Scales, series separating lateral line from origin of second dorsal	9	8	7½	8	8
Denticulations of dorsal spine		13		11	16

[1] Pseudocaudal developed.

(*spinosus*, in reference to the very spiny scales.)

64. LIONURUS INFRANUDIS, new species.

Type-specimen.—Cat. No. 82669, U.S.N.M.; 203 mm. long to end of pseudocaudal, 50 mm. to anus; dredged at *Albatross* station 5586, off Sibuko Bay, Borneo (lat. 4° 06′ 50″ N.; long. 118° 47′ 20″ E.); depth, 347 fathoms; bottom temperature, 44° F.

Fin-rays—first dorsal, II, 12; ventrals, 11; pectorals, 21.

The body is rather slender, the dorsal contour sloping forward in a gently convex curve from the elevated origin of the first dorsal fin to the subconic snout. The horizontal projection of the snout beyond the front of the premaxillaries is equal to the length of the pupil; the preocular length, about 0.2 longer than the preoral length, and equal to the height of the orbit, is contained 3.33 times in the head. The orbit is not quite round, the vertical diameter being a little greater than its horizontal length, which is contained 1.55 times in the postorbital, or 3.6 times in the entire length of the head. The margin and the ridge of the preopercle are not sharply produced backward at the angle, above which they are vertical. The least width of the narrow interorbital space is contained 1.4 times in the orbit, or 2.2 times in the postorbital; the suborbital is narrower than the pupil. The length of the upper jaw, which extends backward to below the posterior half of the pupil, is contained 3.25 times in

the head. The teeth are in the usual bands, that of the upper jaw having an outer series a little enlarged. The length of the barbel is equal to the interorbital width. The gill-membranes unite in a free fold directly below the preopercular ridge; there are seven branchiostegal rays.

The scales are armed by numerous rather long spinules arranged in quincunx order; the last spinules project beyond the margin of the scale. Nine rows of scales separate the origin of the second dorsal fin from the lateral line series.

The anus is about equidistant from the origin of the anal and from the base of the outer ventral ray; it is preceded by a naked area.

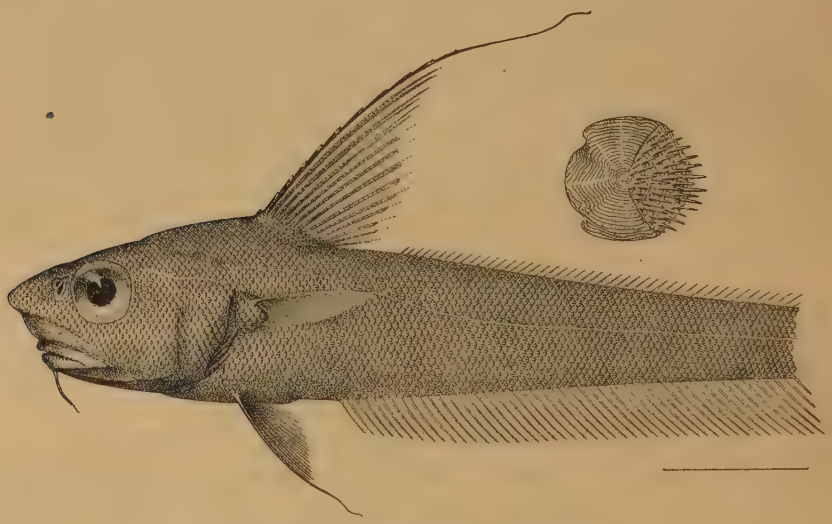

FIG. 38.—LIONURUS INFRANUDIS. TYPE.

The second dorsal spine is longer than the distance between the tip of snout and the origin of the anal fin; the basal half of the spine is armed with 11 widely spaced denticulations. The pectoral and ventral fins are inserted on the same vertical. The inner ventral rays, when depressed, fall short of the origin of the anal.

Color in alcohol, gray-brown, becoming blackish on the belly, opercles, and nasal fossa; pale on the jaws and the underside of the snout. All of the fins, excepting the second dorsal, are black. The buccal and branchial cavities are lined with black, without light margins except along the bands of teeth and at the corners of the mouth; the parietal peritoneum is brownish black laterally, but silvery with black spots ventrally (except about the anus).

Measurements in hundredths of length to anus (50 mm.)—Length of head, 82; length of orbit, 24; width of interorbital, 17; width of suborbital, 10; orbit to preopercle, 31; length of snout, 24; length of

upper jaw, 26; length of barbel, 17; anus to anal, 18; height of second dorsal spine, 128; height of third dorsal ray, 79; interdorsal space, 29; length of pectoral, 42; length of outer ventral ray, 62; length of second ventral ray, 29.

(*infranudis*, having the under surface of the head naked.)

65. LIONURUS EVIDES, new species.

Type-specimen.—Cat. No. 78231, U.S.N.M.; 157 mm. long to end of tail, 33 mm. to anus; dredged with four paratypes at *Albatross* station 5589.

List of paratypes.

Albatross station	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5589	Vicinity of Sibuko Bay, Borneo	260	45.7	4
5621	Between Gillolo and Makyan Islands	298		3

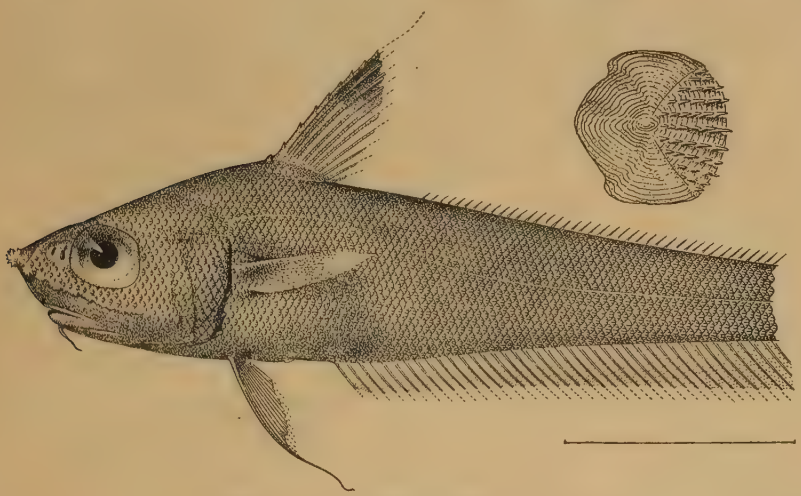

FIG. 39.—LIONURUS EVIDES. TYPE.

This pretty little species is a close representative of *Lionurus condylura*, a Japanese species,[1] from which it differs in the blacker spot on the first dorsal fin, in the longer outer ventral ray, in the fewer denticulations on the dorsal spine, and in the larger scales (see tables of measurements).

Fin-rays—first dorsal, II, 9 (11 to 13); pectoral 21 (20 to 22); ventrals, 11–14 (13 to 15).

The body is deep and elevated at the origin of the first dorsal fin, from which point the dorsal contour extends forward as a convex

[1] See Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 197.

curve to the occiput, thence straight to the subconic snout, which projects beyond the front of the premaxillaries half its horizontal projection beyond the eye. The tip of the snout bears two rather prominent spiny tubercles; preocular length of snout, 3.25 in head; preoral length, 4.0; length of orbit, 3.0. The least interorbital width is nearly equal to the length of the orbit; the suborbital is wider than the pupil. The upper jaw extends backward to below the posterior margin of the pupil; its length is contained 4.4 times in the head. The gill-membranes unite below the preopercular ridge; there are seven branchiostegal rays.

The scales are armed with about 10 slightly divergent rows of spinules. The scales are larger than in *condylura*, there being but 9 (8 to 9½) instead of 11 rows between the origin of the second dorsal fin and the lateral line series.

The center of the anus is a little nearer to the origin of the anal fin than to the insertion of the ventral.

The second dorsal spine, which is strong basally, is armed with 12 (9 to 15) rather large and well-spaced denticulations. The lengths of the various fins are given in the table of measurements.

Color in alcohol, light brown, becoming blackish, with a silvery sheen, on the opercles and over the coelomic cavity. The buccal and branchial cavities are lined wholly with blackish except near the corners of the mouth and along the edge of the opercular and branchiostegal membranes. The black color of the parietal peritoneum is underlain by silvery.

Table of measurements in hundredths of lengths to anus.

Albatross station	5621	5621	5621	5589	5589	[1]5589	5589	5589
Total length in mm	[2]132	131	[2]125	[2]117	[2]146	164	157	107
Length to anus in mm	32.5	31	.....	34	37	.....	33	25
Length of head	75	79	.....	80	78	.....	79	81
Length of orbit	24	26	.....	27	27	.....	27	30
Width of interorbital	19	19	.....	20	19	.....	22	22
Width of suborbital	10	11	.....	12	11	.....	11	12
Orbit to preopercle	24	26	.....	28	27	.....	28	27
Length of snout	22	23	.....	22	22	.....	27	26
Length of upper jaw	22	25	.....	25	23	.....	22	25
Length of barbel	12	15	.....	13	13	.....	12	14
Depth of body	.....	.....	.....	85	80	.....	.....	69
Height of second dorsal spine	68	78	.....	70	78	.....	73	82
Height of third dorsal ray	62	.....	.....	58	.....	.....	64	71
Length of first dorsal base	23	23	.....	27	24	.....	23	26
Interdorsal space	18	27	.....	34	34	.....	32	34
Length of pectoral	39	40	.....	44	43	.....	47	40
Length of outer ventral ray	70	61	.....	.....	62	.....	68	68
Length of second ventral ray	29	.....	.....	.....	27	.....	.....	25
Soft rays, first dorsal	12	11	12	11	11	13	9	11
Ventral rays	14	14,15	13,14	15,15	15,15	15,13	11,14	13,13
Pectoral rays	22	.....	22	.....	.....	20	21	.....
Scales (series separating lateral line from origin of second dorsal)	9	9	8	9	9	9	9	9½
Denticulations of dorsal spine	12	9	.....	15	14	10	12	10
Gill-rakers, second arch	7	.....	8	.....	.....	7	.....	.....
Sex	[3]	[4]	[3]	[4]	[4]	.....	[5]	.....

[1] Type-specimen. [2] Pseudocaudal developed. [3] Male. [4] Adult female.

(*evides*, pretty.)

66. LIONURUS VITTATUS (Weber).

Macrurus vittatus WEBER, Fische der *Siboga*-Expedition, p. 157, pl. 1, fig. 5.

This species, the most strikingly marked of any in the genus, was not obtained by the *Albatross*.

67. LIONURUS RICHARDI (Weber).

Macrurus richardi WEBER, Fische der *Siboga*-Expedition, p. 154, pl. 1, figs. 3 and 3*a*.

This species is a close ally of *L. pumiliceps* and of *L. decimalis*, differing from them in the small number (8) of rays in the ventral fins. No specimens were dredged by the *Albatross*.

68. LIONURUS PUMILICEPS (Alcock).

Macrurus pumiliceps ALCOCK, Journ. Asiat. Soc. Bengal, vol. 63, pt. 2, 1894, pp. 125, 127; Illustrations of the Zoology of the *Investigator*, Fishes, pt. 3, pl. 16, fig. 3; Descrip. Cat. Ind. Deep-sea Fishes Indian Museum, 1899, p. 113.

This species is one of that group of *Lionurus* in which the whole ventral region of the head and trunk has migrated forward from its normal position, the snout is blunt in profile, and projects but little beyond the mouth; the gill-membranes are united below the orbit; the ventral fins are inserted below the middle of opercle; the anus lies before the vertical from the origin of the first dorsal, and is followed by the anal fin after an interval unusually short for a species of the *Lionurus* type of genera.

The reference of our material to the Indian *L. pumiliceps* is made without comparison of specimens. No differences of importance are apparent between our material and Alcock's descriptions, which, however, are not sufficiently complete to render the identification entirely certain.

We present a short description of our specimens, which were obtained at the following stations:

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5439	Off western Luzon	900	36.7	1
5467	Off eastern Luzon	480		2
5469	do	500		1
5587	Vicinity of Sibuko Bay, Borneo	415	42.3	2
5605	Gulf of Tomini, Celebes	647		2
5607	do	761		2
5647	Buton Strait	519		1
5648	do	559	39.2	2
5650	Gulf of Boni	540	40.1	1
5651	do	700	38.7	1
5654	do	805	38.3	1
5655	do	608	39.2	2
5657	do	492	41.3	1
5658	do	510	41.2	1
5660	Flores Sea	692	39.2	1
5661	Macassar Strait	400	43.3	1

Fin-rays—first dorsal 11, 11 or 12; pectorals, 20 to 23; ventrals (39 fins counted), 11 to 13.

The body is very deep, and sharply compressed posteriorly; in some specimens the depth is constricted behind the trunk much more than in others. The origin of the dorsal fin is at the apex of a triangular elevation of the dorsal contour. The horizontal projection of the snout is half as long as the pupil. The least width of the oblique suborbital is a little more than half the orbital length. The barbel is decidedly more than half as long as the orbit. The preopercular ridge is separated above from the orbit by a distance equal to the diameter of the pupil; the ridge is arched backward a little at the angle. There are seven branchiostegals and about eight rudimentary gill-rakers.

The scales are rather small, being in eight or nine series from the origin of the second dorsal to but excluding the lateral line. The scales are reduced in size on the upper and under surfaces of the head; those in front of the anal fin are sometimes enlarged as though vertically fused. In the larger specimens the scales of the body bear six to eight parallel or slightly divergent rows of spinules.

The first dorsal spine is sharp and robust; the second spine may be lower or a little higher than the length of the head; it is armed by 23 to 37 denticulations in four specimens, 39 to 46 mm. long to the anus, and by 16 in one specimen of 33 mm. The interdorsal space is very much longer than the orbit.

For comparison with *L. decimalis* we include the following measurements:

Table of measurements in hundredths of length to anus.

Albatross station	5439	5654	5607	5469	5467
Total length in mm	[1] 227	233	223	207+	144
Length to anus in mm	46	42	40	39	26
Length of head	81	83	80	79	85
Length of orbit	26	29	26	27	30
Width of interorbital	20	22	20	23	22
Width of suborbital	14	14	14	15	15
Orbit to preopercle	31	33	30	32	33
Length of snout	26	29	27.5	26	26
Length of upper jaw	24	29	28.5	32	34
Length of barbel	19	17	.....	16	20
Depth of body	90	84	80	80	81
Anus to anal	9	11	9	9	10
Height of second dorsal spine	91	75	76	70	.....
Interdorsal space	32	37	.....	41	40
Length of pectoral	.....	45	46	.....	.....
Length of outer ventral ray	33	43+	54	62	.....
Length of second ventral ray	.....	.....	.....	33	.....

[1] A pseudocaudal developed.

(*pumiliceps*, in reference to the shortened head.)

69. LIONURUS DECIMALIS, new species.

Type-specimen.—Cat. No. 82668, U.S.N.M.: 155 mm. long, 38.5 mm. to anus; dredged with a single paratype of about the same size at *Albatross* station 5348 in Palawan Passage; 375 fathoms; 56.4° F., bottom temperature.

Fin-rays—first dorsal II, 11 (both specimens); pectoral, 18 (22); ventral, 10 (both sides of both specimens).

This species belongs to that peculiarly formed group typified by *L. pumiliceps*, the last species. The depth of the body, greatest below the highly elevated origin of the first dorsal fin, is one orbital length longer than the head. In the type the ventral contour behind the anus is markedly concave, but is quite straight in the paratype; this variation is paralleled in *pumiliceps*. The head is short and blunt, vertical between the tip of the snout and the mouth. Length of snout in head, 3.6 (3.4); oblique length of orbit, 2.65 (2.7); least interorbital width in postorbital, 1.4 (1.3); least suborbital width less than half the orbital length; barbel much less

FIG. 40.—LIONURUS DECIMALIS. TYPE.

than half as long as the orbit. The small mouth stands at an angle of about 45° with the horizontal, paralleling the sharp suborbital ridge. The vertical preopercular ridge, separated above by the diameter of the pupil from the eye, is only slightly produced backward at its rounded angle. There are 7 rudimentary gill-rakers on the lower limb of the first arch; branchiostegals, 7. The gill-membranes are free forward to below the orbit.

The anus lies a little in advance of the origin of the anal fin, which is almost directly below the origin of the first dorsal. The scaleless peritroct is as wide as the pupil.

Eight rows of scales separate the lateral line series from the origin of the second dorsal fin. Each scale of the body is armed with five to seven parallel rows of spinules. The scales are reduced in size on the cheeks, the under surface of the head and in a strip extending forward from the first dorsal fin and including the top of the head; those along the suborbital ridge are strengthened and angu-

lar; both the terminal and lateral rostral tubercles are studded with stronger spinules.

The interdorsal space is much shorter than the orbit. The second dorsal spine is armed with 34 denticulations.

The coloration in alcohol is mostly blackish-brown, but is much lighter on the upper half of the trunk and head and black over the coelom. The fins are all black, the ventral and anal black. The buccal and branchial cavities are blackish, becoming abruptly light around the inner margin of the upper jaw. The silvery peritoneum is punctate with black and thinly coated with purplish brown.

L. decimalis is sharply distinguished from its close ally, *L. pumiliceps*, in the number of ventral rays, 10 instead of 11 to 13, in the even blunter head, and in certain proportions quite strikingly shown by comparison of the tables of measurements we have prepared for each species. In *decimalis* the following measurements are decidedly shorter: the suborbital width, the distance between the orbit and the preopercular margin, the length of the snout and of the barbel, and the interdorsal space.

Table of measurements in hundredths of length to anus.

	Type.	Paratype.
Albatross station	5348	5348
Total length in mm	[1] 155	[1] 142
Length to anus in mm	38.5	40
Length of head	81	79
Length of orbit	27	25
Width of interorbital	23	24
Width of suborbital	12	11.5
Orbit to preopercle	27	27
Length of snout	21	22
Length of upper jaw	24	22
Length of barbel	9	7.5
Depth of body	90	85
Interdorsal space	19	11
Length of pectoral	47	.....

[1] Pseudocaudal developed.

(*decimalis*, in reference to the number of ventral rays.)

70. LIONURUS PARVIPES (Smith and Radcliffe).

Macrourus parvipes Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43 1912, p. 124, pl. 28, fig. 1.

Lionurus parvipes Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, pp. 202, 205.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5608	Gulf of Tomini, Celebes	1089	36.3	1
5609	do	1092	36.3	2
5636	Pitt Passage	1262	.....	[1] 2
5670	Macassar Strait	1181	38.2	1

[1] One of these specimens, Cat. No. 72941, U.S.N.M., is the type of *Macrourus parvipes*.

We have tabulated the measurements of this species while comparing it with *Lionurus cetonuropsis*, its Japanese representative. (*parvipes*, in reference to the reduced ventrals.)

Genus MATAEOCEPHALUS Berg.

This genus is not intermediate between *Macrourus* and *Coelorhynchus* as Radcliffe[1] has suggested. It is really related to *Lionurus* in a manner analagous to that by which *Coelorhynchus* is related to *Coryphaenoides* (*Macrourus*). The similarity between the two genera, consisting in the production of the snout and in the correlated strengthening of the infraorbital ridge, is due to convergence rather than to common origin.

71. MATAEOCEPHALUS ADUSTUS Smith and Radcliffe.

Mataeocephalus adustus Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 126, pl. 28, fig. 3.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5605	Gulf of Tomini, Celebes	647		1
5606	do	834		1
5630	South of Patiente Strait	569		2
5654	Gulf of Boni, Celebes	805	38.3	Type

This species seems to be distinct from *Mataeocephalus microstomus* (Regan), the only one with which it might be confused.

72. MATAEOCEPHALUS NIGRESCENS Smith and Radcliffe.

Mataeocephalus nigrescens Smith and Radcliffe, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 125, pl. 28, fig. 2.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			°F.	
5219	Between Marinduque and Luzon	530	50.8	3
5348	Palawan Passage	375	56.4	1
5423	Jolo Sea	508	49.8	1
5424	do	340	50.4	1
5425	do	495	49.4	1
5492	Between Leyte and Mindanao	735	52.5	[2] 2
5515	Vicinity of northern Mindanao	([3])		1
5586	Sibuko Bay, Borneo	347	44	2

[1] Proc. U. S. Nat. Mus., vol. 43, 1912, p. 125.
[2] One of these is the type-specimen: Cat. No. 72942, U.S.N.M.
[3] "About 700."

According to the data available, *M. nigrescens* appears to have a more northern distribution than *M. adustus*. *M. nigrescens* is a close ally of the Hawaiian *M. acipenserinus* and of the Panamaic *M. tenuicauda*.

Genus TRACHONURUS Günther.

73. TRACHONURUS VILLOSUS (Günther).

Trachonurus villosus Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 205 (description of Japanese material, with synonomy).—Weber, Fische der *Siboga*-Expedition, p. 165, pl. 5, fig. 2.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° *F.*	
5123	East coast of Mindoro	283		4
5124	do	281		3
5348	Palawan Passage	375	56.4	2
5373	Vicinity of Marinduque Island	338	51.8	4
5407	Vicinity of Dupon Bay, Leyte	350		2
5410	Between Cebu and Leyte	385		1
5423	Jolo Sea (Sulu Sea)	508	49.8	4
5425	do	495	49.4	1
5492	Between Leyte and Mindanao	735	52.3	5
5494	do	678	53.3	6
5512	Vicinity of northern Mindanao	445	52.8	3
5513	do	505	52.8	1
5528	Between Siquijor and Bohol	439	53.3	1
5533	Between Cebu and Siquijor	432	53.3	1
5586	Vicinity of Sibuku Bay, Borneo	347	44	1
5587	do	415	42.3	2
5646	Buton Strait	456		2
5648	do	559	39.2	1

The range of depth and bottom temperature inhabited by this species is remarkably wide for a Macrouroid fish of tropical seas.

We can detect no differences of importance among these specimens nor between them and Japanese material.

Genus CETONURUS Günther.

74. CETONURUS ROBUSTUS Gilbert and Hubbs.

Cetonurus robustus Gilbert and Hubbs, Proc. U. S. Nat. Mus., vol. 51, 1916, p. 207, pl. 11, fig. 2.

List of stations.

Albatross station.	Locality.	Depth in fathoms.	Bottom temperature.	Number of specimens.
			° F	
5601	Gulf of Tomini, Celebes	765		1
5631	South of Patiente Strait	809		1
5632	do	845		4
5651	Gulf of Boni, Celebes	700	38.7	1
5654	do	525	41.2	1

Between these East Indian specimens and the type material from Japan no specific differences can be detected.

COMPLETE LIST OF THE SPECIES OF MACROUROID FISHES OBTAINED AT EACH STATION.[1]

Each of the stations occupied by the *Albatross* during the Philippine cruise, from which Macrouroid fishes were preserved, are listed below, together with the number of specimens of each species. The data is offered as being valuable in presenting the associational distribution of the various forms.

STATION 5110; 135 FATHOMS; BOTTOM TEMPERATURE, 59° F.

Coelorhynchus thompsoni	1
Hymenocephalus striatissimus torvus	1

STATION 5111; 236 FATHOMS.

Coelorhynchus macrolepis	Type+34
Coelorhynchus carinifer	Type
Coelorhynchus macrorhynchus	6

STATION 5112; 177 FATHOMS; 52.4° F.

Coelorhynchus argus	1
Hymenocephalus s. torvus	1

STATION 5113; 159 FATHOMS.

Hymenocephalus s. torvus	1
Ventrifossa nigrodorsalis	1

STATION 5114; 340 FATHOMS.

Hymenocephalus nascens	1
Ventrifossa macronemus	1

"STATION 5115 OR 5116"; 340 OR 200 FATHOMS; (?) OR 50.2° F.

Hymenocephalus nascens	1

STATION 5117; 118 FATHOMS.

Hymenocephalus longiceps	3

STATION 5118; 159 FATHOMS.

Coelorhynchus thompsoni	1
Coelorhynchus argus	1
Hymenocephalus longiceps	1
Hymenocephalus longipes	1
Hymenocephalus s. torvus	2

STATION 5119; 394 FATHOMS; 43.7° F.

Hymenocephalus nascens	1

[1] The detailed data for each station are given in Bureau of Fisheries Document No. 741, 1910.

STATION 5121; 108 FATHOMS.

Coelorhynchus quincunciatus	2
Hymenocephalus longiceps	9

STATION 5122; 220 FATHOMS.

Coelorhynchus smithi	1
Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	2
Ventrifossa nigrodorsalis	6

STATION 5123; 283 FATHOMS.

Gadomus denticulatus	1
Coelorhynchus smithi	3
Trachonurus villosus	4

STATION 5124; 281 FATHOMS.

Coryphaenoides semiscaber	1
Coelorhynchus smithi	2
Ventrifossa nigrodorsalis	6
Trachonurus villosus	3

STATION 5135; 161 FATHOMS; 57.4° F.

Coelorhynchus argentatus	5
Coelorhynchus argus	3
Ventrifossa nigromarginata	2

STATION 5162; 230 FATHOMS; 52.9° F.

Coelorhynchus notatus	Type

STATION 5172; 318 FATHOMS.

Coelorhynchus argentatus	Type+1
Coelorhynchus sexradiatus	Type+1
Coelorhynchus commutabilis	1
Hymenocephalus s. aeger varying toward *H. s. torvus*	33
Ventrifossa nigrodorsalis	2
Ventrifossa nigromarginata	2

STATION 5173; 186 FATHOMS.

Hymenocephalus s. aeger varying toward *H. s. torvus*	1

STATION 5197;[1] 174 FATHOMS; 54.° F.

Hymenocephalus longiceps	1

STATION 5198; 220 FATHOMS; 53.9° F.

Gadomus denticulatus	2
Coelorhynchus smithi	1
Hymenocephalus s. torvus	2
Ventrifossa nigrodorsalis	1
Ventrifossa nigromarginata	1

[1] See discussion of this station on p. 525.

STATION 5201; 554 FATHOMS; 52.8° F.

Gadomus magnifilis	1
Lionurus proximus	1

STATION 5202; 502 FATHOMS.

Lionurus proximus	Type

STATION 5215; 604 FATHOMS; 50.5° F.

Coryphaenoides semiscaber	Type+1

STATION 5216; 215 FATHOMS; 51.9° F.

Hymenocephalus longipes	1

STATION 5219; 530 FATHOMS; 50.8° F.

Bathygadus sulcatus	1
Mataeocephalus nigrescens	3

STATION 5221; 193 FATHOMS; 52.4° F.

Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	10+?3
Ventrifossa nigrodorsalis	6

STATION 5222; 195 FATHOMS; 52.8° F.

Hymenocephalus longipes	1
Hymenocephalus s. torvus	2
Ventrifossa nigrodorsalis	11

STATION 5238; 380 FATHOMS; 43.0° F.

Hymenocephalus barbatulus	Type+1

STATION 5247; 135 FATHOMS.

Coelorhynchus argus	2

STATION 5255; 100 FATHOMS.

Coelorhynchus argentatus	1+?1

STATION 5259; 312 FATHOMS; 49.3° F.

Hymenocephalus s. torvus	4
Ventrifossa nigrodorsalis	1
Ventrifossa divergens	1

STATION 5260; 234 FATHOMS; 51.4° F.

Coelorhynchus, species? (young; poor condition)	1
Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	5+?40
Ventrifossa nigrodorsalis or *divergens* (poor condition)	2
Ventrifossa nigromarginata	2

STATION 5261; 145 FATHOMS.

Ventrifossa nigromarginata	1

STATION 5265; 135 FATHOMS.

Coelorhynchus velifer	1
Coelorhynchus argus	1
Hymenocephalus longiceps	1
Ventrifossa nigromarginata	1

STATION 5268; 170 FATHOMS.

Coelorhynchus velifer	6
Hymenocephalus s. torvus	1+?3
Ventrifossa nigrodorsalis or *divergens* (poor condition)	13
Ventrifossa lucifer	1

STATION 5269; 220 FATHOMS.

Coelorhynchus velifer	1
Hymenocephalus s. torvus	2
Ventrifossa divergens	2

STATION 5274; 525 FATHOMS; 41.3° F.

Bathygadus spongiceps	2
Gadomus introniger	1

STATION 5279; 117 FATHOMS.

Coelorhynchus argentatus	1
Hymenocephalus s. torvus	1

STATION 5280; 193 FATHOMS; 49.6° F.

Coelorhynchus macrolepis	1
Hymenocephalus, species?	3
Hymenocephalus s. torvus	1+?5

STATION 5281; 201 FATHOMS; 50.4° F.

Coelorhynchus macrolepis	1
Ventrifossa nigrodorsalis or *divergens*	3

STATION 5282; 248 FATHOMS; 47.4° F.

Coelorhynchus, species? (young; poor condition)	1
Hymenocephalus s. torvus	7+?15
Hymenocephalus nascens	7
Malacocephalus luzonensis	2
Ventrifossa divergens	2
Lionurus, species? (young)	1

STATION 5283; 280 FATHOMS; 46.8° F.

?Hymenocephalus s. torvus	3

STATION 5284; 422 FATHOMS; 42.3° F.

Ventrifossa divergens	1

STATION 5287; 379 FATHOMS; 43.4° F.

Coelorhynchus, species? (very poor condition)	4

STATION 5289; 172 FATHOMS.

Coelorhynchus velifer	52
Hymenocephalus s. torvus	1
Ventrifossa nigrodorsalis or *divergens*	5
Ventrifossa divergens	16

STATION 5290; *214 FATHOMS.

?Coelorhynchus maculatus	1
Hymenocephalus longiceps	1
Ventrifossa divergens	7

STATION 5291; 173 FATHOMS; 51.5° F.

Coelorhynchus argentatus	1
Coelorhynchus velifer	13
Coelorhynchus argus	8
Hymenocephalus longiceps	11
Hymenocephalus s. torvus	1
Malacocephalus luzonensis	1

STATION 5292; 162 FATHOMS; 52.4° F.

Coelorhynchus velifer	1
Hymenocephalus gracilis	Type
Hymenocephalus longiceps	1

STATION 5293; 180 FATHOMS; 57.4° F.

Coelorhynchus velifer	21
Ventrifossa divergens	3

STATION 5294; 244 FATHOMS; 48.4° F.

Coelorhynchus velifer	Type+1
Hymenocephalus s. torvus	3
Ventrifossa divergens	3

STATION 5296; *210 FATHOMS.

Coelorhynchus velifer	2
Ventrifossa divergens	3

STATION 5297; *198 FATHOMS.

Coelorhynchus velifer	3
Ventrifossa divergens	2

STATION 5298; *140 FATHOMS.

Coelorhynchus argus	2

STATION 5301; 208 FATHOMS; 50.8° F.

Coelorhynchus, species? (young; poor condition)	1
Hymenocephalus longiceps	1
Hymenocephalus s. striatissimus	8

STATION 5310; 100 FATHOMS; 65.5° F.

Hymenocephalus nascens	1
Ventrifossa divergens	1

STATION 5317; 230 FATHOMS; 50.6° F.

Coelorhynchus cingulatus	Type
Hymenocephalus longiceps	1
Hymenocephalus s. striatissimus	5
Ventrifossa nigrodorsalis	1

STATION 5325; 224 FATHOMS; 53.2° F.

Coryphaenoides microps	4
Coelorhynchus cingulatus	1
Coelorhynchus weberi	Type
Hymenocephalus s. striatissimus × *H. s. torvus*	15
Ventrifossa divergens	2

STATION 5326; 230 FATHOMS; 55.4° F.

Coelorhynchus dorsalis	1
Hymenocephalus s. striatissimus × *H. s. torvus*	3

STATION 5328; 150 FATHOMS; 53.9° F.

Hymenocephalus s. striatissimus × *H. s. torvus*	1

STATION 5329; 212 FATHOMS; 51.4° F.

Coelorhynchus dorsalis	Type
Hymenocephalus s. striatissimus×*H. s. torvus*	4
Ventrifossa divergens	1

STATION 5331; 178 FATHOMS; 54.7° F.

Hymenocephalus s. striatissimus×*H. s. torvus*	1

STATION 5348; 375 FATHOMS; 56.4 F.

Coelorhynchus commutabilis	Type
Ventrifossa nigrodorsalis	1
Lionurus decimalis	Type+1
Mataeocephalus nigrescens	1
Trachonurus villosus	2

STATION 5363; *180 FATHOMS.

Coelorhynchus thompsoni	Type
Hymenocephalus s. torvus	12
Ventrifossa nigrodorsalis	8

STATION 5365; *214 FATHOMS.

Coelorhynchus macrolepis	20
Hymenocephalus s. torvus	7+?12
Ventrifossa nigrodorsalis	5
Ventrifossa nigrodorsalis or *divergens*	2

STATION 5366; *240 FATHOMS.

Coelorhynchus maculatus	1

STATION 5367; *180 FATHOMS.

Coelorhynchus macrorhynchus	Type
Hymenocephalus, species? (poor condition)	1

STATION 5368; 181 FATHOMS.

Hymenocephalus s. torvus	1

STATION 5371; *83 FATHOMS.[1]

Hymenocephalus s. torvus	1

STATION 5372; *150 FATHOMS.

Hymenocephalus longipes	1

STATION 5373; 338 FATHOMS; 51.8° F.

Hymenocephalus nascens	2
Trachonurus villosus	4

STATION 5374; *190 FATHOMS.

Coelorhynchus radcliffei	2
Hymenocephalus longipes	5
Hymenocephalus s. torvus	5
Ventrifossa nigrodorsalis	11

STATION 5375; 107 FATHOMS.

Hymenocephalus longiceps	1

STATION 5376; *90 FATHOMS.

Hymenocephalus, species (poor condition)	1

[1] Depth probably erroneously estimated.

STATION 5387; 209 FATHOMS; 52.4° F.

Coelorhynchus argus	1
Hymenocephalus longipes	1

STATION 5388; 266 FATHOMS; 51.4° F.

Ventrifossa nigrodorsalis	6
Ventrifossa nigromarginata	7

STATION 5392; 135 FATHOMS.

Coelorhynchus quincunciatus	Type + 6

STATION 5396; 137 FATHOMS.

Coelorhynchus quincunciatus	1

STATION 5397; 134 FATHOMS.

Coelorhynchus quincunciatus	2

STATION 5403; 182 FATHOMS; 55.7° F.

Hymenocephalus longipes	7

STATION 5404; 190 FATHOMS; 55.4° F.

Ventrifossa nigrodorsalis	1

STATION 5406; 298 FATHOMS.

Gadomus denticulatus	1
Ventrifossa nigrodorsalis	2

STATION 5407; 350 FATHOMS.

Trachonurus villosus	2

STATION 5409; 189 FATHOMS.

Hymenocephalus s. torvus	6
Ventrifossa nigrodorsalis	12

STATION 5410; 385 FATHOMS.

Gadomus denticulatus	1
Trachonurus villosus	1

STATION 5411; 145 FATHOMS.

Hymenocephalus longiceps	7

STATION 5412; 162 FATHOMS; 54.8° F.

Coelorhynchus quincunciatus	1
Hymenocephalus longiceps	3
Hymenocephalus longipes	1

STATION 5417; 165 FATHOMS; 54.4° F.

Coelorhynchus acutirostris	1
Hymenocephalus longipes	1

STATION 5418; 159 FATHOMS; 54.4° F.

Coelorhynchus acutirostris	Type
Hymenocephalus longipes	2
Hymenocephalus s. torvus	1
Ventrifossa nigromarginata	1

STATION 5419; 175 FATHOMS; 54.5° F.

Hymenocephalus s. torvus	1

STATION 5421; 137 FATHOMS; 58.4° F.

Coelorhynchus argus	1
Hymenocephalus longipes	Type

STATION 5423; 508 FATHOMS; 49.8° F.

Bathygadus sulcatus	Type + 4
Gadomus magnifilis	1
Mataeocephalus nigrescens	1
Trachonurus villosus	4

STATION 5424; 340 FATHOMS; 50.4° F.

Bathygadus sulcatus	2
Coelorhynchus smithi	2
Ventrifossa macronemus	Type
Mataeocephalus nigrescens	1

STATION 5425; 495 FATHOMS; 49.4° F.

Mataeocephalus nigrescens	1
Trachonurus villosus	1

STATION 5428; 1105 FATHOMS; 49.7° F.

Coryphaenoides paradoxus	Type
Coryphaenoides camurus	Type

STATION 5439; 900 FATHOMS; 36.7° F.

Lionurus pumiliceps	1

STATION 5440; 172 FATHOMS; 53.2° F.

Hymenocephalus longiceps	1
Hymenocephalus s. striatissimus × *H. s. torvus*	1
Malacocephalus luzonensis	Type

STATION 5441; 186 FATHOMS; 52.2° F.

Hymenocephalus longiceps	1

STATION 5444; 308 FATHOMS; 45.3° F.

Coelorhynchus commutabilis	1
Ventrifossa nigrodorsalis	2
Ventrifossa divergens	2

STATION 5445; 383 FATHOMS; 44.3° F.

Gadomus denticulatus	1
Coelorhynchus commutabilis	1
Coelorhynchus parallelus	3
Hymenocephalus nascens	1
Ventrifossa misakia	1
Ventrifossa nigrodorsalis	2

STATION 5450; 408 FATHOMS; 42.3° F.

Macrouroides inflaticeps	Type

STATION 5453; *146 FATHOMS.

Hymenocephalus longiceps	8

STATION 5454; *153 FATHOMS.

Coelorhynchus quincunciatus	1
Hymenocephalus longiceps	2

STATION 5459; *201 FATHOMS.

Hymenocephalus longiceps	Type+2

STATION 5460; 565 FATHOMS.

Bathygadus spongiceps	2
Bathygadus furvescens	1
Gadomus introniger	1
Coryphaenoides hyostomus	1
Coelorhynchus platorhynchus	1

STATION 5463; *300 FATHOMS.

Lionurus spinosus	1

STATION 5467; *480 FATHOMS.

Bathygadus spongiceps	1
Gadomus multifilis	1
Coryphaenoides hyostomus	2
Lionurus pumiliceps	2

STATION 5469; 500 FATHOMS.

Lionurus pumiliceps	1

STATION 5470; *560 FATHOMS.

Coryphaenoides microps	Type
Coryphaenoides hyostomus	Type
Lionurus spinosus	3

STATION 5476; 270 FATHOMS; 48.3° F.

Hymenocephalus longiceps	1
Hymenocephalus s. striatissimus	19
Malacocephalus luzonensis	1

STATION 5492; 735 FATHOMS; 52.3° F.

Mataeocephalus nigrescens	Type + 1
Trachonurus villosus	5

STATION 5494; 678 FATHOMS; 53.3° F.

Trachonurus villosus	6

STATION 5495; 976 FATHOMS; 52.3° F.

Bathygadus furvescens	1

STATION 5501; 214 FATHOMS; 54.3° F.

Hymenocephalus s. torvus	7
Ventrifossa nigrodorsalis	5
Ventrifossa nigromarginata	3

STATION 5502; **214 FATHOMS.

Coelorhynchus radcliffei	2
Hymenocephalus longipes	1
Hymenocephalus s. torvus	24
Ventrifossa nigrodorsalis	Type + 13
Ventrifossa nigromarginata	1

STATION 5503; 226 FATHOMS; 53.3° F.

Coelorhynchus smithi	1
Coelorhynchus radcliffei	Type
Hymenocephalus s. torvus	8
Ventrifossa nigrodorsalis	8

STATION 5504; 200 FATHOMS; 54.3° F.

Hymenocephalus s. torvus	1
Ventrifossa nigrodorsalis	6

STATION 5505; *220 FATHOMS.

Gadomus denticulatus	Type + 1
Coelorhynchus smithi	1
Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	3
Ventrifossa nigrodorsalis	5
Ventrifossa nigromarginata	1

STATION 5506; 262 FATHOMS; 53.3° F.

Hymenocephalus s. torvus	9

STATION 5508; 270 FATHOMS; 53.3° F.

Hymenocephalus s. torvus	Type + 6
Ventrifossa nigrodorsalis	6
Ventrifossa nigromarginata	1

STATION 5510; 423 FATHOMS; 53.0°. F.

Bathygadus sulcatus	2
Hymenocephalus nascens	1

STATION 5511; 410 FATHOMS; 53° F.

Coryphaenoides dubius	Type

STATION 5512; 445 FATHOMS; 52.8° F.

Trachonurus villosus	3

STATION 5513; 505 FATHOMS; 52.8° F.

Trachonurus villosus	1

STATION 5515; NO SOUNDING, DEPTH ABOUT 700 FATHOMS.

Bathygadus furvescens	1
Gadomus magnifilis	Type
Mataeocephalus nigrescens	1

STATION 5516; DEPTH 175; 54.3° F.

Coelorhynchus argentatus	3
Coelorhynchus acutirostris	1
Ventrifossa nigromarginata	6
Ventrifossa lucifer	Type + 3

STATION 5517; 169 FATHOMS; 54.3° F.

Coelorhynchus argentatus	1
Coelorhynchus acutirostris	1
Ventrifossa nigromarginata	1
Ventrifossa lucifer	1

STATION 5518; 200 FATHOMS; 54° F.

Coelorhynchus argentatus	1
(?) *Coelorhynchus thompsoni*	2
Ventrifossa nigromarginata	2

STATION 5519; 182 FATHOMS; 54.3° F.

Ventrifossa nigromarginata	3
Ventrifossa lucifer	8

STATION 5523; NO SOUNDING.

Coelorhynchus velifer	5
Ventrifossa nigrodorsalis	1
Ventrifossa nigromarginata	1

STATION 5526; 805 FATHOMS; 52.3° F.

Bathygadus furvescens	1

STATION 5527; 392 FATHOMS; 53.3 F.

Bathygadus sulcatus	2
Ventrifossa nigromarginata	1
Lionurus proximus	1

STATION 5528; 439 FATHOMS; 53.3° F.

Bathygadus sulcatus	1
Ventrifossa macronemus	1
Trachonurus villosus	1

STATION 5529; 441 FATHOMS; 53° F.

Bathygadus sulcatus	2

STATION 5533; 432 FATHOMS; 53.3° F.

Trachonurus villosus	1

STATION 5534; 333 FATHOMS; 53.3° F.

Coryphaenoides semiscaber	1

STATION 5535; 310 FATHOMS; 53.3° F.

Coelorhynchus smithi	1
Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	4
Ventrifossa nigrodorsalis	2

STATION 5536; 279 FATHOMS; 53.5° F.

Coelorhynchus smithi	3
Coelorhynchus radcliffei	2
Hymenocephalus s. torvus	2
Ventrifossa nigrodorsalis	4

STATION 5537; 254 FATHOMS; 53.5° F.

Coelorhynchus radcliffei	1
Hymenocephalus s. torvus	11

STATION 5538; 256 FATHOMS; 53.3° F.

Coelorhynchus smithi	1
Ventrifossa nigrodorsalis	1

STATION 5542; 200 FATHOMS; 54.3° F.

Hymenocephalus longipes	2
Hymenocephalus s. torvus	3
Ventrifossa nigrodorsalis	3

STATION 5545; 114 FATHOMS.

Coelorhynchus argentatus	3

STATION 5549; 263 FATHOMS; 52.3° F.

Coelorhynchus argus	4
Hymenocephalus s. aeger, varying toward *H. s. torvus*	1

STATION 5550; 258 FATHOMS; 52.3° F.

Coelorhynchus argentatus	1
Hymenocephalus s. aeger, varying toward *H. s. torvus*	1

STATION 5551; 193 FATHOMS; 53.3° F.

Hymenocephalus s. aeger, varying toward *H. s. torvus*	2
Ventrifossa nigromarginata	1

STATION 5563; 224 FATHOMS; 52.3° F.

Hymenocephalus s. aeger, varying toward *H. s. torvus*	7

STATION 5564; 236 FATHOMS; 52.3° F.

Hymenocephalus s. aeger, varying toward *H. s. torvus*	54

STATION 5565; 243 FATHOMS; 52.3° F.

Coelorhynchus sexradiatus	6
Hymenocephalus longiceps	1
Hymenocephalus s. aeger, varying toward *H. s. torvus*	2
Ventrifossa nigromarginata	1

STATION 5566; 244 FATHOMS; 52.5° F.

Coelorhynchus argentatus	1
Hymenocephalus longiceps	1
Hymenocephalus s. aeger, varying toward *H. s. torvus*	1

STATION 5569; 303 FATHOMS; 52.3° F.

Ventrifossa nigromarginata	1

STATION 5574; 340 FATHOMS.

Coelorhynchus macrorhynchus	1

STATION 5575; 315 FATHOMS; 52.3° F.

Coelorhynchus triocellatus	Type
Coelorhynchus macrorhynchus	1
Ventrifossa nigromarginata	1

STATION 5576; 277 FATHOMS; 53.3° F.

Hymenocephalus s. aeger, varying toward *H. s. torvus*	1
Ventrifossa nigromarginata	1

STATION 5580; 162 FATHOMS; 55.8° F.

Hymenocephalus longiceps	5
Ventrifossa nigromarginata	1

STATION 5582; 890 FATHOMS; 38.3° F.

Bathygadus spongiceps	Type
Gadomus multifilis	1

STATION 5585; 476 FATHOMS; 41.1° F.

Gadomus introniger	1
Coelorhynchus platorhynchus	Type

STATION 5586; 347 FATHOMS; 44.0° F.

Gadomus introniger	1
Coelorhynchus acantholepis	2
Hymenocephalus nascens	11
Ventrifossa nigrodorsalis	3
Lionurus infranudis	Type
Mataeocephalus nigrescens	2
Trachonurus villosus	1

STATION 5587; 415 FATHOMS; 42.3° F.

Bathygadus filamentosus	Type+1
Gadomus denticulatus	1
Coryphaenoides hyostomus	1
Coelorhynchus acantholepis	Type
Coelorhynchus macrorhynchus	1
Hymenocephalus nascens	Type
Lionurus pumiliceps	2
Ventrifossa nigrodorsalis	2
Trachonurus villosus	2

STATION 5589; 260 FATHOMS; 45.7° F.

Gadomus denticulatus	1
Coelorhynchus commutabilis	5
Hymenocephalus s. aeger	26
Hymenocephalus nascens	28
Ventrifossa nigrodorsalis	4
Lionurus evides	Type+4

STATION 5590; 310 FATHOMS; 44.3° F.

Coelorhynchus smithi	1
Coelorhynchus commutabilis	3
Hymenocephalus s. aeger	1
Ventrifossa nigrodorsalis	3
Ventrifossa divergens	1

STATION 5592; 305 FATHOMS; 43.3° F.

Ventrifossa nigrodorsalis	2
Ventrifossa divergens	Type

STATION 5601; 765 FATHOMS.

Bathygadus furvescens	1
Cetonurus robustus	1

STATION 5605; 647 FATHOMS.

Lionurus pumiliceps	2
Mataeocephalus adustus	1

STATION 5606; 834 FATHOMS.

Mataeocephalus adustus	1

STATION 5607; 761 FATHOMS.

Gadomus multifilis	1
Coelorhynchus spinifer	Type
Lionurus pumiliceps	2

STATION 5608; 1089 FATHOMS; 36.3° F.

Coryphaenoides aequatoris	Type
Lionurus parvipes	1

STATION 5609; 1092 FATHOMS; 36.3° F.

Coryphaenoides aequatoris	1
Lionurus parvipes	2

STATION 5619; 435 FATHOMS.

Bathygadus filamentosus	1
Bathygadus entomelas	Type

STATION 5621; 298 FATHOMS.

Coelorhynchus maculatus	Type+5
Coelorhynchus smithi	Type+1
Hymenocephalus longiceps	2
Hymenocephalus s. aeger	Type+37
Ventrifossa divergens	12
Lionurus evides	1

STATION 5622; 275 FATHOMS.

Hymenocephalus nascens	3
Ventrifossa nigrodorsalis	2

STATION 5623; 272 FATHOMS.

Coelorhynchus maculatus	4
Hymenocephalus nascens	1

STATION 5624; 288 FATHOMS.

Gadomus denticulatus	1
Coelorhynchus radcliffei	1
Hymenocephalus nascens	7
Ventrifossa nigrodorsalis	5

STATION 5625; 230 FATHOMS.

Hymenocephalus s. aeger	5
Ventrifossa nigrodorsalis	7

STATION 5626; 265 FATHOMS.

Coelorhynchus radcliffei	1
Hymenocephalus s. aeger	1

STATION 5630; 569 FATHOMS.

Mataeocephalus adustus	2

STATION 5631; 809 FATHOMS.

Cetonurus robustus	1

STATION 5632; 845 FATHOMS.

Coryphaenoides asprellus	Type
Cetonurus robustus	4

STATION 5636; 1262 FATHOMS.

Coryphaenoides orthogrammus	Type
Lionurus parvipes	Type+1

STATION 5646; 456 FATHOMS.

Trachonurus villosus	2

STATION 5647; 519 FATHOMS.

Gadomus introniger	1
Lionurus pumiliceps	1

STATION 5648; 559 FATHOMS; 39.2° F.

Bathygadus spongiceps	1
Gadomus introniger	Type
Coryphaenoides tydemani	4
Coryphaenoides hyostomus	2
Lionurus pumiliceps	2
Trachonurus villosus	1

STATION 5650; 540 FATHOMS; 40.1° F.

Bathygadus filamentosus	1
Lionurus pumiliceps	1

STATION 5651; 700 FATHOMS; 38.70° F.

Gadomus introniger	1
Lionurus pumiliceps	1
Cetonurus robustus	1

STATION 5654; 805 FATHOMS; 38.3° F.

Lionurus pumiliceps	1
Mataeocephalus adustus	Type
Cetonurus robustus	1

STATION 5655; 608 FATHOMS; 39.2° F.

Lionurus pumiliceps	2

STATION 5656; 484 FATHOMS; 41.2° F.

Gadomus introniger	1

STATION 5657; 492 FATHOMS; 41.3° F.

Coelorhynchus platorhynchus	3
Lionurus pumiliceps	1

STATION 5658; 510 FATHOMS; 41.2° F.

Coelorhynchus platorhynchus	3
Lionurus pumiliceps	1

STATION 5660; 692 FATHOMS; 39.2° F.

Lionurus pumiliceps	1

STATION 5661; 180 FATHOMS; 50.5° F.

Ventrifossa nigromarginata	1

STATION 5664; 400 FATHOMS; 43.3° F.

Lionurus pumiliceps	1

STATION 5670; 1181 FATHOMS; 38.2° F.

Lionurus parvipes	1

(Station number lost.)

Bathygadus sulcatus	1
Coelorhynchus macrolepis	1
Hymenocephalus nascens	1
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